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CHEMISTRY.—*A critical survey of the literature dealing with the chemical constituents of* Cannabis sativa.[1] A. H. BLATT, Howard University, in cooperation with the U. S. Treasury Department.

Investigations of the chemical constituents of *Cannabis sativa*, which is the source of marihuana, hashish, and allied narcotics,[2] have been appearing for over eighty years but no surveys of this work, other than those found in the introductory portions of the individual publications, are available. Recent years have seen an increased incidence in the use of marihuana in the United States, and so serious has the problem become that the 75th Congress passed a Federal Marihuana Act in 1937. A direct result of the passage of this Act is a many-sided study of cannabis problems, under the general supervision of the Bureau of Narcotics, and of the office of the Consulting Chemist, U. S. Treasury Department. To facilitate the study of the chemical phases of the problem, and for the use of others interested in the chemistry of cannabis, the present survey has been prepared.

The chemical literature dealing with cannabis is rather extensive but it is filled with contradictions, and the articles which contain significant results are relatively few in number. Consequently, the principal problem in reviewing this literature is one of elimination. In the preparation of this survey, therefore, an effort has been made to examine all relevant publications but no attempt has been made to offer a complete summary and bibliography. Instead, there will be presented only those facts which can be considered as definitely established, together with the much larger amount of information which, though only probably correct, is significant to future workers. In keeping with this point of view the presentation is not strictly historical.

Two chemical individuals, neither one responsible for the characteristic physiological activity of the plant, have been isolated from cannabis. In addition, three other products, none isolated as a pure chemical substance, have been obtained, and the physiological ac-

[1] Received October 1, 1938.
[2] Definitions of cannabis and the more important preparations made from it are given at the end of this article.

tivity has been shown to reside in the third of these. The two chemical individuals are *n*-nonacosane and cannabinol; the three other products are a terpene, a sesquiterpene and crude cannabinol. We shall describe the isolation and chemical study of these substances and products, but it is first imperative to distinguish clearly between cannabinol and crude cannabinol.

The basis for this distinction is the following. Vacuum distillation of extracts made from cannabis yields a high boiling fraction generally referred to as cannabinol or as the "red oil." Most of the chemists studying cannabis obtained this red oil and most of the chemical work on cannabis has been done with this material. Wood, Spivey and Easterfield,[3] however, in 1899 obtained from the red oil a crystalline acetate in a yield of about twenty-five per cent. This preparation was successfully repeated for the first time thirty-two years later by Cahn.[4] Since then a crystalline p-nitrobenzoate has been reported but not described.[5] The isolation, in about a twenty-five per cent yield, of a crystalline ester makes it clear that the red oil is a mixture; it will therefore be referred to henceforth, following Cahn,[4] as *crude cannabinol*, and the term cannabinol without qualification will be reserved for the chemical individual obtained by hydrolysis of the pure, crystalline acetate. Parenthetically, it may be remarked that one major reason for the slow progress made in the attempts to isolate and determine the structure of the active principle of cannabis has been that chemists have worked with an impure material, crude cannabinol, and have assumed that this mixture was a pure compound.

In order to secure from cannabis the two chemical individuals and the three other products mentioned before, either the plant itself, usually the flowering tops, or the resinous exudate, can be used as the raw material. The exudate is, naturally, much richer in active material. Ether, petroleum ether, or alcohol can be used successfully as the solvent for extraction. Alcohol dissolves less of the paraffin hydrocarbon, *n*-nonacosane, present but extracts more chlorophyll than does petroleum ether. The extracts are concentrated and the residue may then be distilled directly or subjected first to a chemical separation using carbonate and caustic. Although fairly elaborate claims

[3] WOOD, SPIVEY and EASTERFIELD, J. Chem. Soc., **75**: 20. 1899. A year earlier DUNSTON and HENRY, J. Chem. Soc., Proc. **1898**, p. 44, reported the isolation of a crystalline cannabinol acetate but they gave no experimental details.

[4] CAHN, J. Chem. Soc., **1931**: 630.

[5] BERGEL, TODD and WORK, Chem. and Ind., **1938**: 86.

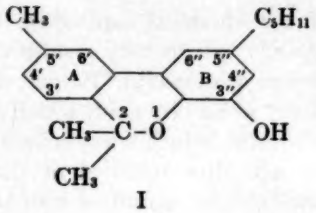
have been made for the chemical separation by some workers,[6,7] others have gotten equally satisfactory results without it and report it to be more troublesome than useful.[4] Bergel[8] reported the isolation from the alkaline extract of an oily acid, which on reduction yielded stearic acid, and a solid acid, which was probably palmitic acid.

From the material left after removal of the extracting solvent Wood, Spivey and Easterfield[9] obtained two principal fractions, a lower boiling one distilled at atmospheric pressure, and a higher boiling one distilled at reduced pressure. Redistillation of the former furnished a terpene and the residue from this distillation yielded, on steam distillation, a sesquiterpene. The residue from the steam distillation was added to the higher boiling principal fraction. This mixture deposited the paraffin hydrocarbon, *n*-nonacosane, and the filtrate, after removal of the hydrocarbon, was redistilled in vacuum and furnished crude cannabinol, the red oil. Other workers have not troubled to isolate the terpene and sesquiterpene and have removed the paraffin hydrocarbon, whenever it appeared, by taking advantage of its sparing solubility in alcohol. The yields of these various products are not particularly significant since different workers started usually with different preparations made from cannabis and none of these preparations is of constant composition; the principal product was, however, always crude cannabinol.

The hydrocarbon, *n*-nonacosane, $C_{29}H_{60}$, was recognized very early as a paraffin[10] but its correct empirical formula was not established until much later.[9] It has recently been definitely identified as *n*-nonacosane although there are indications that it is contaminated with small amounts of some other material.[4] *n*-Nonacosane melts at 63–64° and is physiologically inactive.

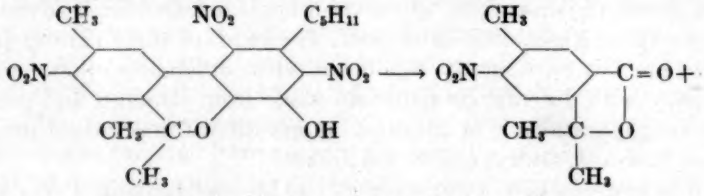
Cannabinol, the second pure chemical individual obtained from cannabis, has the empirical formula $C_{21}H_{26}O_2$. It is a liquid which boils at 263–264°/20 mm.[4] The structure of cannabinol has been fairly definitely established as 3″-hydroxy-2,2,5′-trimethyl-5″-n-amyldibenzopyran (I) although the location of the substituents in ring B is not certain. This structure is a result of the excellent investigations of Cahn, which are in turn based upon the earlier work of Wood, Spivey and Easterfield and are supported by some synthetical experiments of Bergel and Vögele.

[6] Hofmann-LaRoche and Co., Ger. Pat., 285,829 (1913).
[7] Casparis, Pharm. Acta Helv. 1: 210. 1926.
[8] Bergel, Ann. 482: 55. 1930.
[9] Wood, Spivey and Easterfield, J. Chem. Soc. 69: 539. 1896.
[10] Personne, J. Pharm. 31: 47. 1857.



I

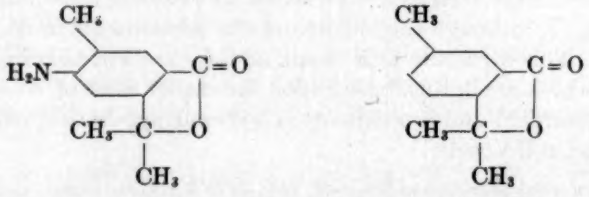
Cannabinol is isolated from crude cannabinol as the crystalline acetate which is then hydrolyzed.[3,4] Cannabinol, and also crude cannabinol, can be nitrated to furnish trinitrocannabinol (II—the positions occupied by the groups in ring B are not definitely known) and the nitric acid oxidation of trinitrocannabinol furnishes *n*-butyric, valeric and caproic acids together with nitrocannabinolactone (III) —also called oxycannabin. Nitrocannabinolactone (III) can be reduced to the aminolactone (IV) and this can be converted, by replace-



II III

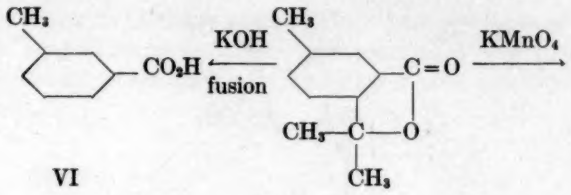
$CH_3(CH_2)_nCO_2H$, where $n=2, 3, 4$.

ment of the amino group by iodine and subsequent reduction, to cannabinolactone (V). Cannabinolactone (V) on alkali fusion yields *m*-toluic acid (VI) and on oxidation with permanganate followed by an alkali fusion furnishes isophthalic acid (VIII) *via* the intermediate

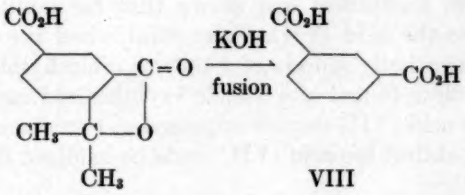


IV V

cannabinolactonic acid (VII). These reactions were first carried out

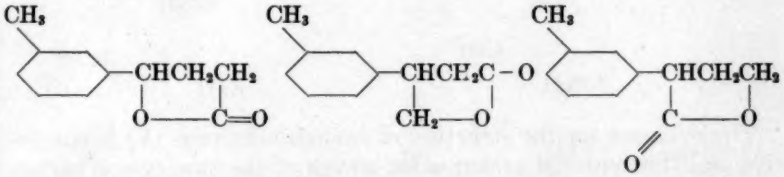


VI V

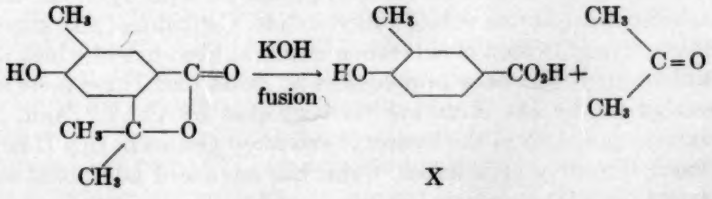


VII VIII

by Wood, Spivey and Easterfield[3] but they formulated cannabinolactone not as the phthalide derivative (V) but as one of the following γ-lactones.

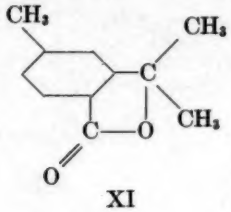


Cahn[11] prepared hydroxycannabinolactone (IX) by diazotization and replacement of the amino group in (IV) by an hydroxyl group. Alkali fusion of this material furnished 6-hydroxy-*m*-toluic acid (X) and acetone, which led to the suggestion of the phthalide structure for this series of compounds. At one time Cahn adopted, then abandoned, the alternative phthalide formula (XI).



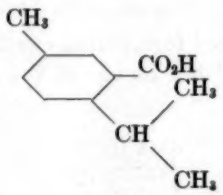
IX X

[11] CAHN, J. Chem. Soc., 1930, 986.

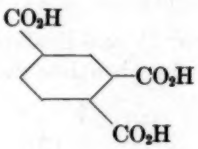


XI

Wood, Spivey and Easterfield had shown that cannabinolactone could be oxidized to the acid (VII). Cahn established the identity of this acid with a synthetic sample of 4-carboxydimethylphthalide. At about the same time Bergel and Vögele[12] synthesized cannabinolactone (V) and the acid (VII) from 6-isopropyl-*m*-toluic acid (XII). Finally, Cahn showed that the acid (VII) could be oxidized to trimellitic acid (XIII).



XII

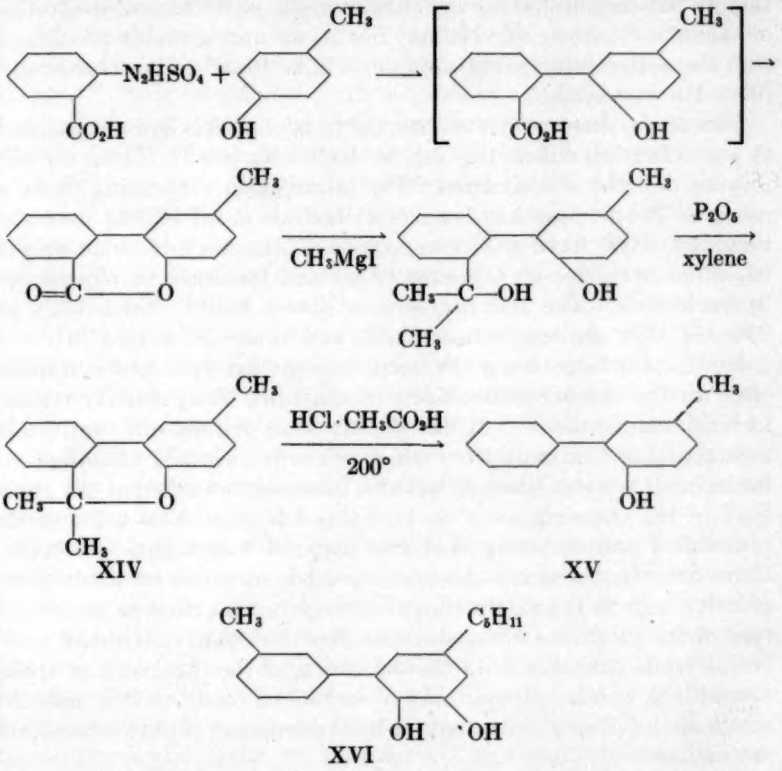


XIII

The evidence for the structure of cannabinolactone (V) is conclusive and this material accounts for eleven of the twenty-one carbon atoms present in cannabinol. Cannabinol also contains an hydroxyl group, shown by the formation of an acetate. This hydroxyl group is, in all likelihood, phenolic, for in acetone with methyl iodide or sulfate and potassium carbonate, cannabinol furnishes a methyl ether. The second oxygen atom in cannabinol is not present as a carbonyl group, for the material does not react with carbonyl reagents; neither is this oxygen atom part of a simple alkoxyl group, for with hydriodic acid cannabinol furnishes no volatile alkyl iodide. Cannabinol also should contain a straight chain of six carbon atoms at least five of which are saturated, for it furnishes caproic acid on oxidation. These facts are accounted for by the structure (I) suggested by Cahn.[13] And, although the positions of the hydroxyl and amyl groups in ring B have not been definitely established, Cahn has advanced additional evidence for the dibenzopyran formula.

[12] BERGEL and VÖGELE, Ann. **493**: 250. 1932.
[13] CAHN, J. Chem. Soc., **1932**, 1342.

2,2,5′-Trimethyldibenzopyran (XIV) was synthesized from anthranilic acid diazonium sulfate and p-cresol.[14] The pyran (XIV), like cannabinol, is unusually stable but it can be cleaved by concen-



XIV XV

XVI

trated hydrochloric acid and acetic acid at 200° to what is probably (XV). Cannabinol on similar treatment furnishes an analogous product, believed to be (XVI), which with alkali gives a purple color similar to that obtained from cannabis in the Beam test (see below). Unfortunately, (XVI) was obtained in such small amounts that a detailed study in order to establish its structure and locate the amyl and hydroxyl groups could not be made. In general, however, the behavior of the pairs, cannabinol (I) and the pyran (XIV), and the phenols (XV) and (XVI) are sufficiently similar to lend confidence to the structures proposed and to suggest both the timeliness and the desirability not only of further synthetical experiments but, particu-

[14] CAHN, J. Chem. Soc., 1933, 1400.

larly, of a detailed study of (XVI) which is the only degradation product of cannabinol in which the two phenyl groups are intact. Cannabinol, it may be mentioned in concluding this discussion, though not responsible for the characteristic physiological properties of cannabis,[14] is toxic,[5] and it may not be an unreasonable prediction that the active principle of cannabis will be found to be structurally related to cannabinol.

Two of the three products obtained from cannabis and not isolated as pure chemical substances can be dealt with briefly. These are the terpene and the sesquiterpene. The information concerning them is meagre. The terpene has been described as an oil boiling over the range 160–180°, having the composition $C_{10}H_{16}$ and molecular weight 65, which resinifies on exposure to air and furnishes an oily monohydrochloride.[9] The sesquiterpene is also a liquid, which boils at 258–259°, has the composition $C_{15}H_{24}$ and molecular weight 101.[9]

Neither the terpene nor the sesquiterpene just described is responsible for the characteristic effects of cannabis. That activity resides in crude cannabinol.[7,8,15] It has already been pointed out that crude cannabinol is a mixture from which the only chemical individual so far isolated is cannabinol. It has also been pointed out that the great bulk of the chemical work on cannabis has been done using crude cannabinol and assuming that this material was a pure substance. Consequently, the many observations made on crude cannabinol are of value only to the extent that they may furnish clues as to the nature of the substance or substances other than pure cannabinol present in crude cannabinol. In the discussion of the chemistry of crude cannabinol which follows, those observations made on this material which are obviously accounted for by the presence of pure cannabinol are omitted.

Crude cannabinol is described as a yellow to red oil which is semi-solid below 60° and can be distilled under reduced pressure. Boiling points recorded for the material are as follows:

Temperature °C.	Pressure in mm	Observer and Reference
315	100	Wood, Spivey and Easterfield[9]
300	46	Wood, Spivey and Easterfield[9]
265	20	Wood, Spivey and Easterfield[9]
210–240	0.5	Fränkel[16]
180–185	0.5	Bergel[8]
183–185	0.05	Casparis[7]
156	0.05	Bergel[8]
160–161	0.005	Casparis[7]

[16] FRÄNKEL, Arch. exp. Path. Pharmakol. 49: 226. 1903.

The composition of crude cannabinol has been given as $C_{18}H_{24}O_2$,[9] $C_{21}H_{30}O_2$,[15] and $C_{20}H_{30}O_2$.[7,8] Molecular weights in agreement with these empirical formulas have been found: 275,[9] 337,[15] and 306,298.[7,8] The refraction, density, optical activity and adsorption spectrum for the mixture have been recorded.[7,8] More useful at the present time than these exact data are certain qualitative observations made by Casparis:[7] crude cannabinol gives no color in alcoholic solution with ferric chloride; it dissolves in acetic acid without the development of color; it dissolves in alcoholic potassium hydroxide to furnish a violet solution whose color changes to yellow upon acidification; it gives a red precipitate in the cold when Millon's reagent is added to its alcoholic solution; it reduces ammoniacal silver nitrate slowly in the cold and rapidly on heating; it does not reduce Fehling's solution. Casparis also tried certain sterol tests with crude cannabinol: when a chloroform solution of crude cannabinol was shaken with concentrated sulfuric acid, a blood red color developed in the acid layer; with acetic anhydride and sulfuric acid a yellow color resulted; with trichloroacetic acid a strawberry red color was obtained; the Liebermann-Burchard and digitonin tests were negative. A direct comparison of the behavior of pure and crude cannabinol toward these various reagents is not available.

Chemical reactions, as opposed to the chemical tests just described, have been tried in large number with crude cannabinol. Casparis and Baur[16] acetylated crude cannabinol and from the hydrolysis of the liquid acetylation product concluded that more than one and less than two acetyl groups per mole had been introduced. Bergel[8] likewise acetylated crude cannabinol but his liquid acetylation product had approximately the composition of a monoacetate of $C_{20}H_{30}O_2$ and showed one acetyl group on hydrolysis. Zerewitinoff determinations by Casparis and Baur and by Bergel indicated the presence of one hydroxyl group in crude cannabinol. Bergel obtained a liquid benzoylation product but Casparis and Baur obtained only tarry products with benzoyl chloride and phthalic anhydride. The latter workers found no reaction with such hydroxyl group reagents as phenyl- or naphthylisocyanate.

Bromination of crude cannabinol gave only intractable products as did the addition of hydrogen chloride.[16] Bromine titration in alcoholic solution indicated the addition of two atoms of bromine and the replacement of two hydrogen atoms by bromine—six atoms of bro-

[16] CASPARIS and BAUR, Pharm. Acta Helv. 2: 107. 1927.

mine were consumed and two moles of hydrogen bromide were formed.[16] Comparable data were obtained by Bergel.[8]

Catalytic reduction of crude cannabinol using a platinum catalyst resulted in the addition of one mole of hydrogen—based on the empirical formula $C_{20}H_{30}O_2$.[8,16] Using a nickel catalyst, reduction was incomplete on the same formula basis.[16] Crude dihydrocannabinol gave the same qualitative tests as crude cannabinol. No crystalline derivatives were obtained from the dihydro product which showed one hydroxyl group in a Zerewitinoff determination[16] and yielded a liquid acetylation product. This acetylation product, which Bergel also obtained by catalytic reduction of crude cannabinol acetate, showed one acetyl group on hydrolysis and gave a negative Millon test.[8] Crude dihydrocannabinol showed two double bonds on bromine titration according to Casparis and Baur while, according to Bergel, only replacement of two hydrogen atoms by bromine took place. Casparis and Baur were unable to reduce crude cannabinol beyond the dihydro stage but Bergel, using platinum oxide and hydrogen at 70–80° and a pressure of 80 atmospheres, obtained a perhydro product whose composition, $C_{20}H_{38}O$, corresponded to the removal of an oxygen atom from, and addition of eight hydrogen atoms to crude cannabinol.

Zinc dust distillation of crude cannabinol and dehydrogenation with sulfur furnished Casparis and Baur with no definite products.

Numerous workers have reported that crude cannabinol undergoes oxidation on exposure to the air and that this oxidation is accompanied by the loss of physiological activity but there is no agreement among different observers either as to the extent or the rate of this loss of activity.[17] Detailed studies of the oxidation of crude cannabinol and dihydrocannabinol have been made by Casparis and Baur and by Bergel. Ammoniacal silver nitrate, chromic acid, permanganate and ozone were used as oxidants but only the latter two furnished definite products. Casparis and Baur reported the formation, without satisfactory identification, of caproic and heptoic acids by permanganate oxidation of crude cannabinol in water-free neutral acetone. Bergel, however, was able to isolate and identify only caproic acid; this acid is known to be formed by the permanganate oxidation of pure cannabinol so that its appearance is without significance. Permanganate oxidation of crude dihydrocannabinol furnished Casparis and Baur, in addition to the acids obtained from crude cannabinol, caprylic acid but Bergel again was able to isolate and identify only caproic acid although he did obtain an unknown acid $C_{10}H_{18}O_2$. Using

[17] MARSHALL, Pharm. J. 1909, p. 418.

ozone, Casparis and Baur reported from crude cannabinol the formation of oxalic, butyric, caproic and isoamylacetic acids, and from crude dihydrocannabinol the formation of oxalic acid, butyric acid and an oenanthic acid. Of these they believe the isoamylacetic acid to be the only one fully identified. However, no direct comparison was made between this acid or its anilide and synthetic material.

The chemistry of crude cannabinol has been described in detail because the active principle or principles of cannabis are present in this material and because, after the removal of pure cannabinol from the crude, the activity is found in the residue.[5] Consequently the point of attack in the isolation and study of the active principle of cannabis must be crude cannabinol from which pure cannabinol has been removed. And since the traditional methods of isolation have been given a more than fair trial by chemists in the past eighty years, primary reliance will have to be placed on newer methods such as adsorption, molecular distillation and the use of solvents at low temperatures. A promising start in the first of these directions has very recently been announced by Bergel, Todd and Work.[5] In future work some guidance can be had from observations already available about crude cannabinol. Thus from the data on bromine and hydrogen addition it is clear that the unknown material in crude cannabinol is in part at least unsaturated; however, a more specific interpretation of these results cannot be made until information about the behavior of pure cannabinol toward the same reagents is at hand. Further, the unknown material in crude cannabinol is at least in part hydroxylic as is shown by Zerewitinoff analyses. Finally, reduction of crude cannabinol and acetylation of the crude dihydro product do not destroy the characteristic physiological activity of the material.

Before the last topic, tests for cannabis, is discussed one striking enigma presented by crude cannabinol should be mentioned. Frequent reference has been made to the fact that experienced chemists for over thirty years have considered crude cannabinol to be a pure substance. Crude cannabinol behaves like a pure substance. The customary high vacuum distillation technique fails to separate it into its constituents. It not only furnishes on analysis values for carbon and hydrogen which are consistent with the composition $C_{20}H_{30}O_2$, but acetylation and reduction yield products whose composition corresponds closely to the expected derivatives of $C_{20}H_{30}O_2$. By the professional chemist the explanation for this remarkable behavior will be eagerly awaited.

Two tests, one old and one new, have been used for the detection

of cannabis in forensic work. The old test due to Beam[18] depends upon the colors produced when alcoholic potash or alcoholic hydrogen chloride acts upon extracts made from cannabis using various solvents. Many modifications of the technique have been made and the reliability of the test has often been questioned. The new test is due to Duquenois and Hassan Negm Moustapha.[19] It depends upon the color given by the residues of cannabis extracts with an alcoholic solution of vanillin and acetaldehyde. Probably because of its newness, this last test has not yet been subject to criticism. A detailed discussion of the techniques, merits and drawbacks of these tests is unnecessary in this place. To the point, is the obvious fact that a forensic test may be based upon either a physiologically inactive or a physiologically active constituent; equally obvious, the latter is preferable. Consequently, now that it is possible to secure a fraction which contains the physiologically active material from cannabis it would seem well worth while to search for specific tests given only by this active fraction.

DEFINITIONS

All definitions have been obtained from the Bureau of Narcotics, U. S. Treasury Department.

There is only one species of hemp, *Cannabis sativa* L., though this has been subdivided into several agronomic types and varieties.

Charas. Raw resin extracted from the tops of the female plant of *Cannabis sativa* L.

Chira. Chira is the name given to charas in the Balkans and North Africa.

Hashish. This term, which is often used as a general term for Indian hemp, is in reality the name given to various preparations of resin or resinous leaves in Egypt, Persia and Turkey.

Esrar. Esrar, which means "secret," is the name given in Turkey to the principal electuary of hemp, obtained with pure water or alcoholized water as the medium.

Madjun. The Arab madjun is a preparation obtained by soaking the inflorescences of the cannabis with butter and water and mixing the fat product which results with nuts, ground almonds, sugar or honey.

Ganja. The ganja of India is composed of flowering or fruiting tops of the cultivated female plants.

Takruri and Kif. The takruri of Tunis or kif of Morocco is made of tops of the female hemp plant, dried and minced small for smoking.

Bhang. Indian bhang is obtained by drying hemp leaves roughly powdered.

Djamba. Djamba is the name given to the hemp cultivated in Central Africa. It is also the name given to the variety of Indian hemp which grows in Brazil.

Marihuana. Marihuana is the name given to the leaves and flowering tops of cannabis. The term is extensively used in the Western Hemisphere and has been defined in The Marihuana Tax Act of 1937 as follows:

"The term 'marihuana' means all parts of the plant *Cannabis sativa* L., whether

[18] C. A. 6: 1952. 1912. The formation of a purple color on treatment of crude cannabinol with alcoholic alkali was observed earlier by Fränkel.

[19] DUQUENOIS and HASSAN NEGM MOUSTAPHA, J. Egypt. Med. Assoc. 21: 224. 1938.

growing or not; the seeds thereof; the resin extracted from any part of such plant; and every compound, manufacture, salt, derivative, mixture, or preparation of such plant, its seeds, or resin; but shall not include the mature stalks of such plant, fiber produced from the stalks, oil or cake made from the seeds of such plant, any other compound, manufacture, salt, derivative, mixture, or preparation of such mature stalks (except the resin extracted therefrom), fiber, oil, or cake, or the sterilized seed of such plant which is incapable of germination."

CHEMISTRY.—*Note on cyanogenesis in* Liriodendron tulipifera *L.* JAMES F. COUCH and REINHOLD R. BRIESE, Bureau of Animal Industry.

Greshoff,[1] by means of a color reaction, detected small quantities of acid in the leaves of tulip tree (*Liriodendron tulipifera* L.) and the Chinese species *L. chinense*, Sarg. He gives no information concerning the quantity of HCN and although the American species is a very common tree no one seems to have checked the observation or determined the HCN quantitatively.

In connection with studies on cyanogenesis in plants that are in progress in this laboratory it was of interest to obtain more exact data on this point. Collections of samples of the leaves were made in 1937 and 1938 from a mature tree 20 to 25 years of age. Other samples were collected from two year old saplings and from seedlings 2 to 7 inches in height. All samples were allowed to macerate in 1% mercuric chloride solution[2] for 4 weeks before analysis to ensure completion of cyanogenesis and no loss of HCN. The results of the analysis are presented in table 1.

TABLE 1.—HYDROCYANIC ACID OBTAINED FROM SEEDLINGS AND LEAVES OF LIRIODENDRON TULIPIFERA

Material used and date collected	Moisture	Hydrocyanic acid in 100 g	
		fresh plant	calcd. to dry matter
	percent	mg	mg
Seedlings, Sept. 20, 1937	75.22	8.7	35.1
Leaves, 2-year-old trees, Sept. 13	54.99	10.2	23.3
Leaves, mature tree, Sept. 13	66.51	2.5	7.1
Leaves, mature tree, May 30, 1938	75.01	14.9	62.1

These data indicate that the quantities of potential HCN in this tree vary with age and season in a manner similar to that observed with other cyanogenetic plants like sorghum, Sudan grass and the wild cherries. The first three samples were collected at about the same date and the younger plants contained the larger quantity of potential HCN. The largest quantity was furnished by leaves collected in the spring from the mature tree and amounted to nearly nine times

[1] GRESHOFF, M., *Phytochemical Investigations at Kew.* Bul. Misc. Inf. Kew, 10: 412. 1909.

[2] BRIESE, R. R. and COUCH, J. F., J. Agric. Res. 57: 81–107. 1938.

the quantity present in leaves from the same tree collected during the preceding September. The quantities of HCN obtained from these samples are, however, well below the toxic limit of 20 mg provisionally established as the minimum concentration of HCN in sorghum that will cause poisoning in animals. There is little danger of poisoning of livestock by leaves of the tulip tree.

The distillates from the analytical samples were tested for benzaldehyde and acetone and none was found. No clue was obtained as to the nature of the cyanogenetic compound present in the leaves.

BOTANY.—*Eleven new American Asteraceae.*[1] S. F. BLAKE, Bureau of Plant Industry.

Of the eleven new species of Asteraceae described in this paper, four were collected by Mrs. Ynes Mexia in Ecuador, in the course of her work for the Division of Plant Exploration and Introduction, Bureau of Plant Industry, United States Department of Agriculture, and four in Chiapas by E. Matuda. The others are from Costa Rica, Texas, and Mexico, collected by A. F. Skutch, B. H. Warnock, and Mrs. Ruth Q. Abbott respectively. A few minor forms and new combinations are included.

Vernonia polypleura Blake, sp. nov.

Frutex (?); caulis et inflorescentia densissime rufescenti-pilosula; folia oblonga majuscula utroque acuminata obscure calloso-serrulata chartacea supra lucidula in pagina subdense pilosula pilis mox deciduis basibus minutis exceptis in costa pilosa subtus dense griseo-pilosa pilis patentibus penninervia nervis ca. 13–15-jugis subtus prominentibus; cymae racemiformes axillares et terminales subpedales subrectae v. parum curvatae saepius basi semel furcatae hinc illinc bracteatae; capitula sessilia subremota 21-flora mediocria; involucri ca. 7-seriati valde gradati 6 mm alti subcampanulati appressi phyllaria exteriora anguste triangularia ad lanceolata acuminata media oblongo-lanceolata acuta interiora anguste oblonga mucronulata infra apicem paullum contracta, omnia subcoriacea pallide brunnea prope apicem laxe pilosa; achenia erecto-pilosa; pappi pallide brunneo-albidi squamellae persistentes lineari-lanceolatae acutae ca. 0.5 mm longae 0.15 mm latae, setae facile deciduae 4 mm longae ad apicem paullulum clavellatae.

Probably shrubby; stem herbaceous above, solid, with pale brown pith, bluntly sulcate-angled, 5 mm thick, very densely and softly pilosulous with straight spreading brownish hairs; leaves alternate; internodes 1–1.5 cm long; petioles slender, naked, densely pubescent like the stem, 1.5–2.8 cm long; blades oblong or elliptic-oblong, 15–18 cm long, 3.8–5 cm wide, acuminate and somewhat falcate, at base acuminate, plane, above brownish green, somewhat shiny, at first rather densely pilose, the hairs quickly deciduous leaving small light-colored bases, along the costa persistently pilose,

[1] Received July 23, 1938.

not glandular, beneath on surface densely and softly griseous-pilose and sessile-glandular, on the costa densely spreading-pilosulous, on the veins densely pilose with mostly antrorse hairs, penninerved, the chief veins subparallel, prominulous above, prominent beneath, the secondaries prominulous-reticulate; cymes solitary in the upper axils and terminal, 15–32 cm long (including peduncle, this 3–7 cm long), the heads mostly 1–1.5 cm apart, frequently in part subtended by reduced leaves (0.8–6 cm long); heads in fruit (as pressed) 7 mm high, 8–11 mm thick; receptacle shallowly alveolate; corollas (not normally developed?) erect-puberulous on teeth, 4.8 mm long (tube 2.3 mm, throat 0.5 mm, teeth triangular, 2 mm long); achenes oblong, 10-ribbed, brownish, 1.8 mm long, rather densely erect-pilose chiefly between the ribs, eglandular; pappus double, the squamellae numerous, the bristles about 50.

MEXICO: Mt. Orando, Chiapas, 23 Dec. 1936, *E. Matuda* 730 (type no. 1,686,105, U. S. Nat. Herb.; dupl., herb. Univ. Mich.).

Despite its occasionally but never uniformly bracteate cymes, this species is evidently a member of the *Scorpioideae aphyllae*, related to *Vernonia brachiata* Benth. and *V. scorpioides* (Lam.) Pers. In *V. brachiata* the leaves are larger, obovate, sessile or subsessile, sharply serrate or serrulate, and, like the stem, only sparsely pubescent. In *V. scorpioides* the leaves are smaller, shorter-petioled, mostly broader in proportion to their length, variable in pubescence but never with that of *V. polypleura*, and with much less numerous and less conspicuous veins; the cymes are much shorter; the involucre is shorter and much more densely and evenly pubescent, and the inner phyllaries are acuminate.

Eupatoriastrum opadoclinium Blake, sp. nov.

Frutescens?; caulis (v. ramus) infra inflorescentiam simplex densissime brunneo-pilosus, internodiis foliis multo brevioribus; folio oblongo-ovata ca. 12 cm longa 4 cm lata decussate opposita obtuse acuminata basi leviter cordata brevissime petiolata crenata subcoriaceo-chartacea penninervia utrinque prominulo-reticulata supra brunneo-pilosula subtus dense brunneo-pilosa; capitula subcylindrica ca. 12 mm alta, 43–47-flora dense et fastigiate cymoso-paniculata, pedicellis capitulis subaequalibus; involucri ca. 11 mm alti ca. 10-seriati valde gradati phyllaria oblonga v. oblongo-ovalia in linearia transeuntia apice rotundata straminea albida 3-vittata margine crispe ciliolata ceterum glabra dorso rotundato-convexa; receptaculum ubique paleatum, paleis angustissime lineari-spathulatis glabris flores subaequantibus; corollae ut videtur albidae; achenia tenuia in costis hispidula.

Stem (or branch) solid, terete, 5 mm thick, very densely and sordidly subtomentose-pilose with spreading somewhat matted many-celled acuminate brownish hairs about 1 mm long; internodes 2–4 cm long; petioles broad, thick, unmargined, densely pubescent like the stem, 2–4 mm long; leaf blades oblong-ovate, 10–12.5 cm long, 3.2–5.2 cm wide, broadest near the middle, rather shortly acuminate to an obtuse apex, crenate throughout except toward apex with rounded or obtuse teeth or toward base crenate-serrate with obtusely callous-pointed teeth (teeth 12–15 pairs, 0.5–1 mm high, mostly 4–7 mm apart), above brownish green, somewhat shining, brownish-pilosulous chiefly along veins and veinlets (densely so along costa) with many-celled spreading hairs, beneath somewhat yellowish brown, densely pilose with spreading lax many-celled hairs, feather-veined, the chief lateral

veins about 5–7 pairs, curved-anastomosing, 2 or 3 pairs near middle of leaf stronger than the others; panicle terminal, rounded, many-headed, dense, 12–15 cm wide, densely pubescent like the stem, the lowest branches subtended by not reduced leaves, the uppermost bracts linear to lanceolate, 5–10 mm long, the pedicels slender, densely pubescent like the stem, 5–10 mm long, often bearing a linear bract; heads (moistened) campanulate-cylindric, 12–13 high, 5 mm thick; phyllaries very numerous, the outermost oblong, about 3 mm long, 1.5 mm wide, pilosulous on back and ciliolate, the middle ones oblong to oval, 3.5–5 mm long, about 2 mm wide, laxly ciliolate but otherwise glabrous, the inner linear or linear-spatulate, about 7.5 mm long, 1–1.3 mm wide, obscurely ciliolate, the inmost narrowly linear-spatulate, similar to the pales of the disk; all the phyllaries except the inmost shallowly boat-shaped, the upper ones in the dried state somewhat lax at tip but not spreading; receptacle flattish, foveolate, 1.5 mm wide; pales of the receptacle very narrowly linear-spatulate, nearly equaling the flowers, stramineous, 1-nerved, 9–9.5 mm long, glabrous except for the obscurely ciliolate, obtuse or rounded, somewhat inflexed apex, this about 0.7 mm wide; corollas apparently whitish, subcylindric, without distinct throat, subsessile-glandular below and on teeth, 6 mm long (tube 2.8 mm, throat 2.8 mm, teeth deltoid-ovate, acute, 0.4 mm long); achenes brownish black, slender, 4.3 mm long, with stipitiform base (0.7 mm long), sparsely hispidulous on the 5 whitish ribs; pappus 1-seriate, persistent, of about 34 whitish, minutely hispidulous, not apically thickened, somewhat unequal bristles, the longest 5 mm, the few shorter ones about 3.5 mm long; anther tips ovate, obtuse or slightly emarginate; style branches linear, not evidently clavate, the finely papillose appendage 2 mm long, slightly longer than the stigmatic lines.

MEXICO: Mt. Orando, Chiapas, *E. Matuda* 702 (type no. 1,685,252, U. S. Nat. Herb.).

In external appearance this is very similar to the section *Cylindrocephala* of *Eupatorium* and utterly distinct from the two species of *Eupatoriastrum* hitherto known (from southern Mexico and El Salvador), which have broadly ovate or deltoid, slender-petioled leaves, broad heads in looser inflorescences, and broad involucres of acute or acuminate phyllaries of different texture and either subequal or much less conspicuously graduate. Careful dissection, however, shows that every flower in the head is subtended by a pale, and it is necessary to refer the species to *Eupatoriastrum* or to suppress the latter genus, a course which seems unjustified. Separation of the species as a new genus based on the differences mentioned would certainly not be advisable in this group. In the texture and convexity of its phyllaries *E. opadoclinium* is very similar to the Brazilian *Eupatorium epaleaceum* (Gardn.) Robinson. *Eupatorium epaleaceum* and *E. horminoides* (DC.) Baker, both Brazilian, constitute the section *Chromolaena* of *Eupatorium*, which makes a definite approach to *Eupatoriastrum* in having the receptacle paleaceous here and there but never, apparently, throughout as in *Eupatoriastrum*.

Mikania melastomacea Blake, sp. nov.

Scandens; caulis firmus medullosus (medulla solida alba) dense sessili-

glandulosus ceterum glaber, nodis brunneo-pilosulis exceptis; folia ovalia mediocria brevipetiolata breviter et obtuse acutata basi late rotundata v. rotundato-cuneata integra pergamentacea 5-plinervia supra dense subtus densissime sessili-glandulosa; capitula parva racemosa, racemis laxis paniculatis; involucri 4.5 mm alti phyllaria linearia obtusa ad apicem pilosula; corolla albida, tubo fauce campanulata longiore, dentibus fauce subduplo brevioribus; achenia 2.5 mm longa apice puberula; pappus albidus corollam aequans.

Series *Racemosae;* stem herbaceous above, subterete or obscurely hexagonal, multistriatulate, with solid white or in age brownish pith, 4 mm thick, light brown, apparently rarely branched below the inflorescence; leaves opposite; internodes 3–8 cm long; petioles slender, naked, not appendaged, densely sessile-glandular and rather densely but inconspicuously hirsute-pilose with several-celled mostly appressed hairs, 1–1.5 cm long; blades oval, 6.5–10.5 cm long, 3.5–6 cm wide, rather abruptly and very obtusely short-pointed, above dark green, scarcely or not at all shining, on surface densely dotted with shining brown glands and sparsely and inconspicuously puberulous with several-celled hairs, along the chief veins hirsute-pilose, glabrescent, beneath brownish green, very densely dotted with sessile brownish yellow glands, sparsely and obscurely puberulous on surface and more densely so on veins, 5-pli- or obscurely 7-plinerved within 0.5–1.5 cm of base, the nerves prominulous beneath, flattish above, the chief veinlets rather numerous, somewhat prominulous on both sides, spreading from the costa at nearly a right angle, with the tertiaries loosely and inconspicuously reticulate; racemes rather sparsely puberulous with weak mostly incurved hairs and sparsely sessile-glandular, loosely flowered (internodes mostly 2–4 mm long), mostly 4–8 cm long, compounded into a large convex terminal panicle about 30 cm long and 18–30 cm wide; bracts of inflorescence minute, subulate, 1.5 mm long, the pedicels very slender, 2–3 mm long; heads 4-flowered, slender, 5–6 mm high; involucre ebracteolate, 4.5–4.8 mm long, the phyllaries 4, subscarious, brownish, obscurely ciliolate, sparsely sessile-glandular, toward apex pilosulous, at base corky-thickened and shortly calcarate; corollas "whitish," sparsely subsessile-glandular on tube and teeth, about 3.4 mm long (tube 1.7 mm, throat campanulate, longer than wide, 1.2 mm, teeth deltoid-ovate, acute, 0.5 mm long); achenes olivaceous, 5-ribbed, at apex minutely puberulous and with a few sessile glands, 2.2–2.5 mm long; pappus whitish, 3–3.5 mm long, the bristles about 38–39, minutely hispidulous, clavellate at apex.

Ecuador: Vine climbing small trees, in clearing in forest, near Puyo, Prov. Napo-Pastaza, alt. ca. 400 m., 20 Feb. 1935, *Ynes Mexia* 6947 (type no. 1,692,970, U. S. Nat. Herb.).

A member of the series *Racemosae*, nearest *Mikania houstoniana* (L.) Robinson. In that species the stem is hollow and weak and the leaves are normally ovate, thinner, and longer-petioled, although exhibiting considerable variation.

Mikania eupatorioides Blake, sp. nov.

Frutex scandens; caulis teres multistriatus cavus pilosulus; folia ovata v. lanceolato-ovata petiolata mediocria longe acuminata basi cuneata prope basin 5-plinervia subintegra tenuiter herbacea supra dense in venis et sparse in pagina subglandulari-puberula et sparse pilosula subtus obscure pilosula et glandulis flavulis adspersa; capitula mediocria cymoso-paniculata saepius

breviter pedicellata, paniculis specialibus parvis terminalibus et axillaribus incurvo-puberulis cunctis paniculam thyrsoideam foliosam efformantibus; bracteola ovata v. oblongo-ovata acuta herbacea apice puberula 2.6–3 mm longa; involucri 6 mm alti phyllaria oblonga acutiuscula basi suberosa prope apicem sparse puberula; corollae anguste infundibuliformes, dentibus erectis fauce triplo brevioribus.

Series *Thyrsigerae;* "woody vine, with white flowers"; stem 5 mm thick, brownish, glabrescent; branches slender, essentially straight, greenish or brownish, rather densely pilosulous with several-celled spreading or upcurved hairs and somewhat dotted with sessile glands; internodes of branches 3–5 cm long; leaves opposite; petioles slender, naked, 1–1.8 cm long, pilosulous or puberulous chiefly above, connected at base by a narrow pilosulous line but not appendaged; blades 11.5–15 cm long, 3–6 cm wide, long-acuminate with somewhat falcate tip, sharply cuneate or the larger rounded-cuneate at base, entire or very obscurely denticulate with small remote teeth, thin, not thickened on the obscurely ciliolate margin, green on both sides, quintuplinerved within 1–2 cm of base, above densely subglandular-puberulous on the chief veins and sparsely so on surface, also sparsely pilosulous on surface, beneath sparsely and obscurely pilosulous or puberulous on veins and surface with several-celled hairs and dotted with sessile yellowish glands, the primary nerves and their chief lateral veins prominulous beneath, the veinlets translucent; individual panicles convex, pubescent like the stem, small, 3–5 cm wide, the lower and middle ones surpassed by the subtending leaves, the whole forming an open leafy thyrsoid panicle (7) 15–24 cm long and 8–15 cm wide; ultimate bracts of inflorescence lanceolate, 3–10 mm long, mostly shorter than the peduncles; pedicels slender, 2 mm long or less, often bearing a small bract; heads 4-flowered, 7–9 mm high; involucre 5.5–6 mm high, the phyllaries 4, narrowly oblong, acutish, thin, greenish with narrow pale thinner margin, weakly about 5-nerved, puberulous toward tip, glabrous below, corky-thickened at base but not calcarate; corollas more or less gland-dotted, sparsely puberulous below or subglabrous, about 4.5 mm long (tube 1–1.2 mm, throat narrowly funnelform, 2.5 mm, teeth 5, broadly ovate, acutish, 0.8 mm long, erect or somewhat inflexed below the apex); achenes slender, 5-angled, toward apex puberulous and with a few sessile glands, 3 mm long; pappus flesh-colored, 4.2 mm long, of 47–50 minutely hispidulous bristles, very obscurely thickened toward apex.

Costa Rica: Edge of forest, vicinity of El General, Prov. San José, alt. 1525 m., Dec. 1936, *A. F. Skutch* 3041 (type no. 1,643,504, U. S. Nat. Herb.); same data, alt. 1070 m., *Skutch* 3017.

The gross appearance of this plant, with its straight branches, is very suggestive of *Eupatorium*. Its only close allies in Central America are *Mikania hylibates* Robinson, *M. nubigena* Robinson, and *M. pittieri* Robinson, the types or type collections of which are all in the United States National Herbarium. In *M. hylibates* the leaves are thin-coriaceous and 3–5-nerved from the very base, with thickened, nerviform, glabrous margin, and the stem is glabrous. In *M. nubigena* the stem and petioles are completely glabrous, the leaves are coriaceous and conspicuously thickened but not ciliolate on margin, the (young) inflorescence is much looser and more open, and the heads are sessile. In *M. pittieri* the stem, petioles, and leaves are glabrous, the leaves are coriaceous and with a perceptibly thicker and paler

margin, the heads are sessile, and the proper tube of the corolla is nearly as long as the campanulate limb.

Mikania iodotricha Blake, sp. nov.

Scandens; caulis dense longe villosus pilis purpureis vel interdum brunneis; folia deltoideo-ovata acuta basi cordata v. subtruncata grosse crenato-serrata v. majora dupliciter crenato-serrata bene petiolata crassiuscula supra viridia bullata hirsuta pilis basi incrassatis subtus purpureo-villosa lacunoso-reticulata e basi 3–5-nervia; capitula majuscula 10–12 mm alta numerosa pedicellata cymoso-paniculata, paniculis majusculis rotundatis; involucri 10 mm alti phyllaria lineari-oblonga acuta medio suberosa margine submembranacea purpurascentia purpureo-pilosa; corolla 7 mm longa purpurea, tubo faucem campanulatam aequante, dentibus fauce triplo brevioribus; achaenia glabra.

Series *Corymbosae;* "vine, climbing 2 m"; stem herbaceous above, subterete, striatulate, hollow, 3.5 mm thick, opposite-branched, densely spreading-villous with many-celled purple hairs (or sometimes light brown) becoming brown and 3–4 mm long in age, pilosulous between them, in age glabrescent, light-brown-barked, and roughened with the persistent bases of the longer hairs; leaves opposite; internodes of main stem 4–10 cm long, those of the branches shorter; petioles stout, unmargined, densely purple-villous, those of the larger leaves 8–18 mm long, slightly enlarged at base and connected by a fringe of cilia but not appendaged; blades 2.8–4 cm long, 2.6–3.6 cm wide, merely acute, at base shallowly cordate or truncate-rounded and usually very shortly cuneate-decurrent on the petiole, above evenly but not densely hirsute with spreading brownish hairs with conspicuously thickened yellowish white persistent bases, beneath densely purple-villous especially on the exserted veins and veinlets; leaves of the inflorescence similar but smaller, the uppermost reduced to lanceolate or linear-spatulate bracts 7 mm long or less; panicles terminal and in the upper axils, trichotomously divided, 6–15 cm wide, purple-villous, the pedicels slender, sparsely villous, 2–10 mm long; involucre obconic, 10 mm high, slightly shorter than the flowers, ebracteolate, 4-flowered, the phyllaries 4, linear-oblong, about 2 mm wide, merely acute but often involute-margined above and appearing acuminate, usually purple-tinged especially above, with somewhat corky-thickened body extending about half their length and submembranous greenish margin, obscurely 5-nerved, scarcely calcarate, thinly pilosulous with white hairs and slightly ciliate, the outer purple-pilose especially above the middle, the inner very sparsely so at apex; corollas mulberry-purple, about 7 mm long, glabrous except on teeth (tube 3 mm, throat campanulate, considerably longer than wide, 2.7–3 mm, teeth ovate, erectish, 1–1.2 mm long, puberulous with few-celled blunt hairs); achenes brownish with 5 white ribs, 5.2 mm long, 1.3 mm wide, essentially glabrous or with a very few hairs on the ribs; pappus brownish, purplish-tinged, 6–6.5 mm long, of about 89 subequal minutely hispidulous bristles, not thickened at apex.

ECUADOR: Occasional in open woods, trail from Olivos to Morán, Cantón Tulcán, Prov. Carchí, alt. 3400 m., 12 July 1935, *Ynes Mexia* 7469 (type no. 1,692,986, U. S. Nat. Herb.).

A very distinct species of the series *Corymbosae,* resembling *Mikania aristei* Robinson of the series *Thyrsigerae* in pubescence and foliage. In all features except its 5-ribbed achenes the plant so much more closely re-

sembles such species of the genus *Kanimia* (distinguished by having 7–10-ribbed achenes) as *K. corymbulosa* (Benth.) B. & H. and *K. violascens* Robinson, particularly the latter, as to suggest that the generic distinction is a rather artificial one.

Mikania napensis Blake, sp. nov.

Scandens; caulis et rami subglabri, ramulis inconspicue puberulis; folia ovata majuscula pergamentacea petiolata acuta v. breviter acuminata base late rotundata or cuneato-rotundata in margine leviter revoluto obscure calloso-serrulata 5–9-plinervia supra lucida utrinque inconspicue puberula; capitula mediocria 8–9 mm alta cymoso-paniculata, paniculis rotundatis; involucri 4 mm alti phyllaria oblonga rotundata puberula; corolla ca. 5.3 mm longa "virescenti-lutea," tubo faucem infundibuliformi-campanulatam aequante, dentibus deltoideis fauce subquintuplo brevioribus; achenia sparse puberula; pappus pallide brunneus.

Series *Corymbosae;* stem herbaceous above, subterete, multistriatulate, hollow, olivaceous, 5 mm thick, sparsely and obscurely puberulous with many-celled subappressed hairs, spreading-branched, the branchlets more densely but still inconspicuously puberulous; leaves opposite; internodes mostly 5–12 cm long, shorter or longer than the leaves; petioles rather stout, naked except at apex, not appendaged at base, finely subappressed-puberulous, those of the larger leaves 12–18 mm long; blades ovate to broadly ovate, 8–13.5 cm long, 4–9.5 cm wide, at base very shortly cuneate-decurrent on the petiole, above shining, light green and appearing glabrous but under a strong lens sparsely subappressed-puberulous, beneath dull green, evenly but not densely puberulous with several-celled subappressed hairs, 5–7 (–9)-plinerved within 1–2 cm of the base, loosely prominulous-reticulate beneath, not puncticulate, the veinlets by transmitted light appearing densely dotted by orange glands; panicles terminal and in the upper axils, compounded, 4–5 cm wide, densely but inconspicuously sordid-puberulous with mostly incurved hairs, essentially ebracteate; heads 4-flowered, mostly in ultimate groups of 2–3, sessile or on pedicels 2 mm long or less; bractlet linear-lanceolate, acute, 1–1.5 mm long; phyllaries 4, oblong or obovate-oblong, 1.5–1.8 mm wide, broadly rounded at apex, corky-thickened but not calcarate at base, with thickish greenish about 7-vittate body and thinner paler narrower margin, ciliolate, rather sparsely subappressed-puberulous below, densely so above; corollas "greenish yellow" (appearing yellowish white when dry), sparsely puberulous toward tip, about 5.3 mm long (tube 2.3–2.5 mm, throat funnelform-campanulate, 2.5–2.7 mm, teeth deltoid, 0.3–0.5 mm long); achenes greenish, 5-ribbed, sparsely erectish-puberulous, 3 mm long; pappus brownish, 5–5.3 mm long, of about 58–63 minutely hispidulous bristles, not thickened at apex; style appendages densely hispidulous, the hairs about as long as the breadth of the branches.

ECUADOR: Vine, climbing small trees in forest border, frequent near Archidona, Cantón Napo, Prov. Napo-Pastaza, alt. 650 m, 19 Apr. 1935, *Ynes Mexia* 7259 (type no. 1,692,951, U. S. Nat. Herb.).

A species of the series *Corymbosae*, allied to *Mikania seemannii* Robinson and *M. tafalla* Humb. & Bonpl., but distinct from both in its much shorter involucre; related about as closely to several other species of western South America, such as *M. aschersonii*, *M. lehmannii*, and *M. multinervia*, but distinguished from all of these by features of foliage, involucre, or corolla.

Aplopappus trianthus Blake, sp. nov.

Frutex tenuis cortice albo, ramis erectiusculis tenuibus hornotinis pallide viridibus viscidis paullum striatis sparse scabro-tuberculatis; folia alterna sparsa lineari-filiformia semiteretia supra sulcata subtus rotundata subpollicaria apice saepius breviter recurva et subobtuse calloso-apiculata sparse tuberculata obscurissime punctata; capitula minima 3-flora homogama discoidea sessilia v. brevissime pedicellata in apicibus ramulorum pollicarium per 3–5 coartata; involucri obconici appressi 4 mm alti ca 5-seriati valde gradati phyllaria pauca (ca. 12–13) linearia obtusa chartacea albida apice viridia et incrassata infra apicem breviter ciliata ceterum glabra; corollae aureae bilabiatae; achenia oblonga 5-nervia dense erecto-pilosa 2 mm longa; pappi straminei subbiseriati 4 mm longi setae ca. 30 subrigidae minute hispidulae; appendices ramorum styli subulato-lineares subacuminate hispidulae partem stigmatiferam subaequantes.

Twiggy shrub, the main stem up to 3 mm thick, subterete, with fissured white glabrous bark, the erectish branches about 30 cm long, whitish below, pale green above; internodes mostly 4–8 mm long; leaves erectish to somewhat spreading, without axillary fascicles, 8–20 mm long, about 0.7 mm wide, rounded and nerveless beneath, flattish and slenderly sulcate above, or the smaller subterete, the upper gradually reduced, the younger obscurely punctate; heads in flower 7–8 mm high, sessile or on pedicels up to 2.5 mm long, crowded in groups of about 3–5 at tips of naked or few-leaved branchlets, the branchlets usually about 5–7, racemosely arranged toward tip of branches, mostly 8–25 mm long, their bracts much shorter than the heads; involucre 4–4.5 mm high, 2 mm thick (when moistened), the phyllaries sometimes in rather definite vertical ranks, somewhat boat-shaped, 0.5–0.7 mm wide, whitish, chartaceous, and 1-nerved below, thinner and subscarious toward margin, with much shorter, thickened, not evidently glandular green tip, short-ciliate below the apex; receptacle small, naked; corollas glabrous or sparsely hispidulous on lower part of throat, 4.8–5.2 mm long (tube about 2–2.2 mm, throat cylindric-funnelform, not sharply delimited from tube, about 1.3–1.7 mm, teeth unequal, one on outside of the flowering head 1.5 mm long, the others united into a 3–4-toothed lamina with essentially equal teeth 0.5–0.7 mm long); pappus 4 mm long, somewhat graduated, rather indefinitely about 2-seriate, the principal bristles slightly but definitely flattened, a few shorter outer ones capillary, half as long as the inner; style branches 2–2.7 mm long, the linear-subulate subacuminate hispidulous appendages (1–1.3 mm long) equaling or very slightly longer than the stigmatic area.

Texas: Frequent along road from Study Butte to Terlingua, Chisos Mountains area, Brewster Co., 31 Aug. 1937, *B. H. Warnock* 1126 (type no. 1,728,979, U. S. Nat. Herb.).

The affinities of this species are unquestionably with *Aplopappus sonoriensis* (Gray) Blake of Lower California and islands, Sinaloa, and Sonora, a member of the section *Ericameria*. In habit, foliage, inflorescence, and involucre the two plants are strikingly similar, the most significant difference being that the young branches and foliage of *A. sonoriensis* are profusely glandular-punctate, while *A. trianthus*, although viscid on the younger parts, is only very obscurely impressed-glandular. In *A. sonoriensis* the receptacle normally bears one or few subulate pales, undoubtedly representing that excessive development of the walls of the alveolae which is not infrequent

in Astereae, and not to be regarded, as Hall suggested, as "remnants" of walls of the alveolae; the flowers are more numerous (about 4–7); the corolla teeth are normally equal and rather longer; the pappus is more copious and less stiff, all the bristles being essentially capillary; and the style appendages are rather broadly triangular and several times shorter than the stigmatic lines. The tendency of the phyllaries in *A. trianthus* to fall into rather definite vertical ranks, suggesting relationship with the very poorly differentiated genus *Chrysothamnus*, is found to a less extent in *A. sonoriensis* and was commented on by Hall.

The apparently normally bilabiate corollas of *A. trianthus* constitute a rather striking feature, which is probably correlated with the reduced number of flowers in the head. Those flowers in which the larger (inner) lip is made up of only 3 teeth are tetramerous, having only 4 stamens. Flowers with the inner lip 3- or 4-toothed occur in the same head. It is surprising that Hall[2] was unable to detect the presence of ray flowers in *A. sonoriensis*, since they are by no means of rare occurrence. In his original description of *Ericameria diffusa* (a synonym of *A. sonoriensis*) Bentham described the disk flowers as 4–5 and the ligule as solitary, shorter than the disk, subbilabiate, often with two linear lobes at base; Gray in 1873 mentioned the occasional presence of one or two imperfectly ligulate marginal flowers; and I described the rays as 0–2, small, in my treatment of the Asteraceae in Standley's *Trees and shrubs of Mexico*. In the specimens in the U. S. National Herbarium of *Palmer* 815 (of 1890) and *Brandegee* (20 Nov. 1904, Altata, Sinaloa), both examined and cited by Hall, rays are present and can be seen with the hand lens. A typical head examined contained 7 flowers, 4 tubular and hermaphrodite, 3 pistillate and imperfectly ligulate, the lamina of the ray in each being 1–1.5 mm long, in two cases shorter than the style branches, in the other longer. In one the lamina was 3-toothed and bore 2 linear lobes at the base, just as described by Bentham; in another the outer lip was unequally 3-toothed, with a single inner lobe of nearly the same length; and in the third the lamina was deeply 2-lobed with one of the divisions 2-toothed and there were no inner lobes. In another head one of the pistillate flowers had an unequally 4-toothed outer lip and a considerably shorter inner lobe, and there were 3 style branches. The significant differences between such flowers and the bilabiate ones of *A. trianthus* are that in *A. sonoriensis* such flowers are pistillate and the large lip is exterior, while in *A. trianthus* the flowers are hermaphrodite and the large lip is interior.

Aplopappus viscidus (Woot. & Standl.) Blake

Sideranthus viscidus Woot. & Standl. Contr. U. S. Nat. Herb. 16: 180. 1913.

In his monograph of "Haplopappus," Hall did not give this plant independent rank, but regarded it a form of his *Haplopappus spinulosus* ssp. *scabrellus* (Greene) H. M. Hall, listing it as "minor variation 32" of *H.*

[2] *The genus* Haplopappus 272. 1928.

spinulosus. The specimens on the type sheet in the U. S. National Herbarium, collected by E. O. Wooton near Hope, Eddy County, New Mexico, 3 August 1905, all lack the root. A specimen in the National Arboretum Herbarium (no. 33,359), collected near edge of Caprock, Lea County, New Mexico, 5 September 1937, by Dan King (no. 72), agrees with the type in all essential characters and possesses the greater part of its root, which is clearly annual. All the forms of *Aplopappus spinulosus* are perennial. *Aplopappus viscidus* appears to be a fairly distinct species, marked not only by its annual root but by its dense glandularity, its oblong or obovate merely serrate primary leaves, and its lack of any bristle on the tip of the phyllaries.

Lea County, where this specimen was collected, is of relatively recent creation, and is not shown on older maps. It is the southeasternmost county in New Mexico, and was formed from about the eastern two-fifths of Eddy and Chaves Counties. Caprock is in the northwestern part, in the Staked Plains, in what was formerly Chaves County, and is in about the same latitude as Roswell.

Erigeron inornatus f. **pseudoradiatus** Blake, forma nov.

Capitula pseudoradiata, corollis exterioribus 10–12 radiiformibus parvis discum paullum superantibus 5.4–6 mm longis lavandulaceis, staminibus abortivis liberis donatis, tubo 1.5–1.8 mm longo, fauce tubulosa 1.5–3.5 mm longa, lamina 1.5–3.5 mm longa elliptica concava 3-denticulata interdum prope basin dentibus 1–2 minoribus donata.

NEVADA: Open sunny places among rocks, public camp ground, Mt. Rose, 7 miles west of Reno Hot Springs, Washoe Co., alt. 1700 m. (6100 ft.), 12 July 1937, *W. A. Archer* 5580 (type no. 37,207, Nat. Arboretum Herb.).

This rather insignificant form is given a name only because it so simulates *Erigeron foliosus* Nutt. in its pseudoradiate heads that it might be confused with that species. Other collections by Dr. Archer in the National Arboretum Herbarium (nos. 5595, 5668, 5807) from the same general region agree precisely in every way except in having discoid heads, and show that the plant should be appended as a form to *E. inornatus* and not to *E. foliosus*, which is not known from Nevada. Forma *pseudoradiatus* is very similar to *E. inornatus* f. *subradiatus* Blake,[3] but in that plant the false rays are pale yellow; in both forms the disk is yellow as normal in *E. inornatus*. The type locality (Tahoe Tavern) of f. *subradiatus* was wrongly given as in Eldorado County in the original description; it is really in Placer County. All these plants agree in being referable to the var. *viscidulus* Gray, as at present understood, rather than to the typical form, having the stem and leaves densely pubescent and the involucre hispidulous or both glandular and hispidulous. *P. B. Kennedy* 1913, also from Washoe County, the basis for the inclusion of the species in Tidestrom's "Flora of Utah and Nevada," is similar. Typical *E. inornatus* Gray, with the stem glabrous at least above and the involucre glabrous, is not known from Nevada.

[3] This JOURNAL 19: 270. 1929.

Desmanthodium caudatum Blake, sp. nov.

Herbaceum (?) verisim. elatum subglabrum, ramis inflorescentiae lineatim pilosulis exceptis; folia ovata pro genere maxima subpedalia falcate caudato-acuminata in basim late alatam abrupte angustata conspicue connato-perfoliata papyracea crenato-serrata e basi laminae trinervia supra subglabra subtus in nervis laxe brunneo-pilosa v. subglabra; capitula parva 9–11-flora glomerulata, glomerulis numerosissimis paniculam subnudam v. foliaceo-bracteatam pro genere laxam 23–28 cm latam efformantibus.

Upper part of stem herbaceous, 4–6 mm thick, with solid or hollow pith, brown, rounded-striate, glabrous below the inflorescence; leaves opposite; internodes 5–8 cm long; leaves at base of branches of inflorescence 22–30 cm long (including the winged petiole), 7–13 cm wide, gradually narrowed into a long falcate attenuation with obtusish callous tip, broadly cuneate at base into the winged petiole, rather coarsely crenate-serrate except at lower part of base of blade and at apex (teeth about 20–35 pairs, 1–2.5 mm high, 4–7 mm apart, with very blunt mostly incurved callous tips), above deep green, slightly shining, obscurely puberulous along costa and chief veins or there essentially glabrous, toward margin somewhat bullate and sparsely hirsutulous with slightly tuberculate-based hairs, beneath somewhat lighter green, laxly sordid-pilose along the chief veins and veinlets or essentially glabrous, 3-nerved from base of proper blade and lightly prominulous-reticulate beneath; petioles broadly winged throughout and conspicuously connate-clasping at base, 5–7.5 cm long, 1.3–2.5 cm wide, entire or with one or two small teeth above, the abruptly dilated clasping base about 1–1.8 cm wide; leaves of the inflorescence smaller, not connate-perfoliate, subsessile or very short-petioled; panicle somewhat convex, the primary branches erectish, the others divergent-ascending, all usually densely sordid-pilosulous in 1 or 2 lines, the ultimate ones more or less compressed, slender, 2–20 mm long, the ultimate bracts lance-ovate, acute, subcoriaceous, about 3 mm long; glomerules 6–10 mm thick, 4–5 mm high, composed of several or many heads and subtended by about 2 appressed bracts, these ovate, 3–4 mm long, obtuse or acutish, subcoriaceous, thinner-margined, about 7-nerved, sparsely pilosulous on base of midrib and slightly ciliolate at base; heads about 4–5 mm high, 3 mm thick; involucre of 3–5 bracts (each subtending a pistillate flower inclosed in its phyllary), these ovate to lance-ovate, acute or acutish, 3–5-nerved, glabrous or sparsely pilosulous on midrib above, 3–4 mm long; pistillate flowers 3–5 (usually 3), each enclosed in a sac-like, submembranous, short-beaked, more or less compressed or trigonous phyllary about 3.5 mm long and 1.5 mm wide, ciliate on the angles, short-pilose above outside; corolla cylindrical, fleshy, whitish, obscurely 3-denticulate at apex, 0.7 mm long, less than half as long as the style; achenes slenderly obovate, plano-convex or 3-angled with concave sides, blackish, glabrous, epappose, 2–2.5 mm long; receptacle naked inside the pistillate flowers; hermaphrodite (sterile) flowers 6–7, their ovaries stipitiform, subglabrous or slightly hispidulous above, up to 3.5 mm long, their corollas white, sparsely hispidulous above, 3.2 mm long (tube 1 mm, throat campanulate, 1.2 mm, teeth 5, ovate, erect, 1 mm long).

MEXICO: Finca Juarez, Escuintla, Chiapas, 12 Aug. 1937, *E. Matuda* 1750 (type no. 1,689,119, U. S. Nat. Herb.); same locality and date, *Matuda* 1756.

The only other species of *Desmanthodium* with connate-perfoliate leaves, *D. perfoliatum* Benth. of Guerrero and Oaxaca, has much smaller leaves (not over 14 cm long and 4.5 cm wide), strongly glaucous beneath and not cau-

date-tipped, a relatively dense and much smaller panicle (about 10 cm wide or less), and hermaphrodite corollas that are densely short-pilose on the limb.

Clibadium mexiae Blake, sp. nov.

Caulis supra densissime molliter breviterque subtomentoso-pilosus pilis patentibus griseis; folia magna longe petiolata late ovata acuminata basi late rotundata v. obscure cordata (minora breviter cuneata) grosse crenato-serrata triplinervia tenuiter papyracea supra scabriuscula dense hirsutula et sparsius hirsuta pilis patentibus basi tuberculatis subtus in pagina subdense et juventate subgriseo hirsuto-pilosa pilis patentibus basi vix incrassatis et glanduloso-adspersa in nervis densissime pilosula et hirsuto-pilosa; capitula minima sessilia irregulariter approximata 3–3.5 mm alta; phyllaria 3 ovata ad suborbicularia acuta v. acutiuscula hispidula et ciliolata 3–7-nervia; fl. fem. 3, hermaph. 6; receptaculum intra fl. fem. nudum v. subnudum; achenia late ovalia basi rotundata apice pilosa et glandulosa 2.3 mm longa.

"Perennial herb, 4 m high"; stem herbaceous above, subterete, white-pithy, 4 mm thick, opposite-branched above; leaves opposite; upper internodes 3–13 cm long; petioles slender, naked, densely pubescent like stem, those of the leaves of the main stem directly below the inflorescence 7–10.5 cm long, of the rameal leaves 1.3–4 cm long; blades of the larger leaves (directly below the inflorescence) broadly ovate, 18 cm long and more (tip wanting), 10–16 cm wide, broadly rounded or obscurely cordate at base, not at all decurrent on the petiole, loosely prominulous-reticulate beneath, 3- or 5-plinerved, coarsely crenate-toothed (teeth depressed, mucronulate, 1.5 mm high or less, 3–5 mm apart); branch leaves ovate, 8–15 cm long, 5–10.6 cm wide, with falcate-acuminate subentire tip, subtruncate to bluntly short-cuneate at base; panicles terminating stem and branches, convex or flattish, 6–11 cm wide, many-headed, densely and griseously subtomentose-pilose with spreading hairs, their branches divergent, their bracts minute, subulate, about 1 cm long or less; heads very small, obovoid-subglobose, 3–3.5 mm high (corollas fallen), 2–2.5 mm thick; phyllaries 3, whitish, the outermost ovate, acute, 3–4-nerved, hispidulous and short-ciliate, 2–2.5 mm long, 1.6–1.8 mm wide, the others broadly oval to suborbicular, 3–3.3 mm long, 2–2.8 mm wide, 5–7-nerved, acutish or abruptly short-pointed, hispidulous toward apex and short-ciliate; receptacle naked inside the pistillate flowers or with a single oblong pale, the pales of the pistillate flowers suborbicular, obtuse, about 5–7-nerved, short-ciliate, 2.5–3.3 mm long; pistillate corollas white, 1.5 mm long, sparsely sessile-glandular above, otherwise glabrous, subequally 5-toothed, the ovaries densely pilose at tip; hermaphrodite corollas (scarcely mature) rather densely short-pilose above, 2 mm long, the ovaries linear, densely long-villous above, sparsely so below, 1.8 mm long; achenes broadly oval-obovate, rounded at base, obcompressed, densely short-pilose and white-glandular toward apex, 2.3 mm long, 1.8 mm wide.

ECUADOR: Common in forest clearing, near Puyo, Prov. Napo-Pastaza, alt. ca. 400 m., 20 Feb. 1935, *Ynes Mexia* 6946 (type no. 1,692,969, U. S. Nat. Herb.).

A species of the general group of *C. surinamense*, most nearly allied to *C. sodiroi* Hieron. and *C. oligandrum* Blake, the former Ecuadorian, the latter Guatemalan. All three agree essentially in the small number of flowers in the heads (3–5 pistillate, 4–6 hermaphrodite). In *C. oligandrum* the leaves

are much narrower (3–6.5 cm wide) and acutely cuneate at base, and the heads are larger; in *C. sodiroi* (from description) the branches are setose-hirtous with reclinate hairs, the leaves are smaller, on shorter petioles (1–1.5 cm long), and the heads are much larger (5 mm long).

Rumfordia media Blake, sp. nov.

Caulis subsparse pilosus; folia deltoidea v. triangulari-ovata utroque latere 1–2-hastato-dentata calloso-serrulata acuminata in petiolos ubique alatos basi connatos abrupte angustata membranacea 3-nervia supra sparse pilosa subtus dense cinerascenterque subtomentoso-pilosula; capitula radiata aurea majuscula parum numerosa cymoso-paniculata, pedicellis glanduloso-pilosis; phyllaria exteriora ovata acuminata 1.5 cm longa 4–8 mm lata extus puberula et glandulosa, interiora stipitato-glandulosa et sparse pilosa; radii 10–11 mm longi.

Doubtless tall, the lower part not seen; upper part of stem herbaceous, bluntly 6-angled, somewhat compressed, striatulate, hollow, 3–4 mm thick, brownish green, not densely short-pilose and puberulous with several-celled mostly wide-spreading hairs with scarcely enlarged base; leaves opposite; internodes 6–8 cm long; petioles narrowly cuneate, winged throughout, 3–9 cm long, 1–2 cm wide at apex, 3–8 mm wide at base and there slightly ampliate and connate, remotely callous-serrulate, pubescent like the blade; leaf blades 10–17 cm long, 6–14 cm wide, callous-serrulate essentially throughout (teeth somewhat unequal, mostly 0.5 mm high or less and 2–5 mm apart), 1–2-hastate-toothed on each side at base of blade (teeth broadly triangular, acute, 1 cm long or less), above deep green, evenly but not densely short-pilose with several-celled lax spreading hairs slightly enlarged at base, beneath especially in youth densely and griseously subtomentose-pilosulous with lax several-celled hairs, somewhat pilose along costa, 3-nerved from base of blade, loosely prominulous-reticulate especially beneath; leaves at base of panicle much reduced, 3–4.5 cm long, their petioles connate at base; panicle terminal, about 15–20-headed, convex or flattish, 10–16 cm wide, the bracts very small, 1 cm long or less, the pedicels slender, 1.5–4.5 cm long, densely pilosulous with gland-tipped hairs and less densely pilose with several-celled longer hairs; heads about 2.8 cm wide at maturity, the spread involucre about 3.8 cm wide; disk 8–11 mm high, 1–1.8 cm thick; outer phyllaries 5, spreading or reflexed at maturity, ovate, lance-ovate, or elliptic-ovate (unequal in breadth in the same head), at maturity 15–17 mm long, 4–8 mm wide, thin-herbaceous, 3–5-plinerved and veiny, outside rather thinly puberulous and both stipitate- and sessile-glandular, densely and finely griseous-puberulous on margin, inside essentially glabrous; inner phyllaries (subtending the rays) ovate, acuminate, densely stipitate-glandular and sparsely pilose, ciliolate, 6 mm long; rays about 10–13, golden yellow, fertile, the tube at maturity 4.5–5 mm long, stipitate-glandular and sparsely hirsute, bearing 2 abortive stamens at apex, the lamina linear-elliptic, 10–11 mm long, 2–2.5 mm wide, pilosulous on back, 3-toothed (teeth blunt, 0.7–1.5 mm long), 8-9-nerved; disk corollas very numerous, fertile, their corollas golden yellow, about 6.5 mm long (tube much swollen at base, stipitate-glandular and sparsely hirsute, 3–3.2 mm, throat slender-campanulate, sparsely stipitate-glandular, 2.8 mm, teeth ovate, pilose, 0.7 mm long); pales membranous, oblong or obovate-oblong, obtuse to acute, subsessile-glandular, short-hirsute, and ciliate, 4–5 mm long; achenes of ray and disk similar, obovoid, plump, obscurely quadrangular, brownish black, glabrous, epappose, 2 mm long, 1 mm wide.

MEXICO: Mt. Orando, Chiapas, 20 Dec. 1936, *E. Matuda* 710 (type no. 1,686,103, U. S. Nat. Herb.; dupl., herb. Univ. Michigan).

This species is somewhat intermediate between *Rumfordia aragonensis* Greenm., of Costa Rica, and *R. attenuata* Robinson, of Michoacan or Guerrero, combining the connate-based, completely winged petioles of the former and the glandular-pubescent pedicels and longer rays of the latter species.

Wulffia baccata var. **discoidea** Blake, var. nov.

Capitula discoidea.

ECUADOR: Scandent perennial herb up to 3 m. high, with orange flowers and black fruit, thicket along trail side, trail from Tena to Napo, Cantón Napo, Prov. Napo-Pastaza, alt. 400 m., 5 April 1935, *Ynes Mexia* 7170 (type no. 1,692,980, U. S. Nat. Herb.); leaning herb with orange flowers, in partial opening in forest, Hacienda Salento, Cantón Pujilí, Prov. León, alt. 1000 m., 19 Nov. 1934, *Mexia* 6702.

Beyond the discoid heads, I can find no character to distinguish this plant from the somewhat variable *Wulffia baccata* (L.f.) Kuntze, in which the rays are sometimes deciduous soon after flowering. Dissection of heads of the new form in which the flowers have not yet opened shows that no rays are present. The involucre is short (4–5 mm high) and the phyllaries rather broadly ovate or oblong-ovate, acute or sometimes obtuse, or the inner occasionally subacuminate.

Psacalium mollifolium Blake, sp. nov.

Herba plusquam 70 cm alta, basi invisa; folia basalia suborbicularia 17 cm longa et lata peltata 7-lobata supra viridia subaspere pilosa pilis multiloculatis subtus densissime mollissimeque albido-lanato-tomentosa, lobis late cuneatis 3–4.5 cm longis 3.5–5.5 cm latis 3–lobatis obtusis sparse mucronulato-denticulatis; caulis densissime glanduloso-puberulus sparse laxeque pilosus pilis multiloculatis infra inflorescentiam simplex infra medium folium peltatum 5-lobum 8 cm latum, supra medium folium non peltatum 3-lobum valde reductum gerens; inflorescentia racemiformis ca. 22 cm longa, ramis brevibus 1-2-cephalis, bracteis linearibus pedunculos subaequantibus dense glanduloso-puberulis piloso-ciliatis; capitula ca. 12 discoidea nutantia ca. 24-flora; bracteolae 5–6 lineares involucro paullo longiores, dense glanduloso-puberulae et piloso-ciliatae; involucri ca. 1.5 cm alti glanduloso-puberuli et sparsius pilosi phyllaria 13 oblongo-lanceolata subacuminata; tubus corollae limbo multo longior, limbo paene ad basin 5-partito; achenia glabra; pappus albus 11 mm longus.

Stem scapiform, rather slender (5 mm thick below), greenish white, subterete, multistriate, solid, pithy; basal leaf attached to the petiole 3.5 cm above base, palmately 7-nerved, papery, the callous mucronulations of the teeth 1 mm long or less, the petiole (incomplete) stout, densely lanate-tomentose, 10 cm long; petiole of the lower stem-leaf about equaling the blade; bracts of inflorescence linear, 2–4 cm long, 2.5–4 mm wide, acute, sessile, entire, somewhat pilose dorsally; peduncles mostly 2–4 cm long, naked or essentially so; disk in flower 1.8–2 cm high, 1.1–1.7 cm thick (as pressed), oblong-campanulate; bractlets of involucre linear or lance-linear, acuminate, 2–2.5 cm long, 1.5–2 mm wide, erectish, herbaceous; phyllaries

2–3 mm wide; corollas apparently white, about 14.3 mm long (tube 8.5 mm, throat campanulate, 0.8 mm, teeth narrowly triangular, acute, recurved, 5 mm long); achenes oblong, greenish white, somewhat flattened, multistriate, 4.8 mm long; pappus pure white, rather copious, 11 mm long; style branches elongate, linear, recurved, obtuse, dorsally densely short-hispid, the hairs extending to slightly below the fork.

MEXICO: Taxco, Guerrero, 12 Aug. 1937, *Ruth Q. Abbott* 353 (type, Gray Herb.).

Nearest *Psacalium conzattii* (Rob. & Greenm.) Rydb., but readily distinguished by the dense, soft, lanate tomentum of the lower leaf surface. The specimen was sent for identification by Dr. I. M. Johnston. The genus *Psacalium* Cass., reestablished by Rydberg, seems to be well defined, and the following species from Jalisco should be transferred to it.

Psacalium eriocarpum Blake

Cacalia eriocarpa Blake, Journ. Washington Acad. Sci. **19**: 279. 1929.

ZOOLOGY.—*A new species of fish of the family Disparichthyidae from off Cuba.*[1] LEONARD P. SCHULTZ, United States National Museum. (Communicated by L. STEJNEGER.)

Disparichthys herrei n. sp.

This new species differs from *Disparichthys fluviatilis* Herre, first described in Field Museum Natural History, Publication **335,** Zoological Series **18** (12): 383–384, fig. 31, 1935. Type locality, a brook at Marienberg, Sepik River, New Guinea and also in Herre's 1936 paper,[2] the only other species in the genus and the only genus in the family Disparichthyidae, by having different proportions of the body as indicated in the following description.[3]

Holotype.—A specimen 174 mm in total length taken in a dipnet by Dr. Paul Bartsch on the Smithsonian-Roebling Exploring Expedition, April 8, 1937, at Corrientes Bay anchorage, as it came up to a submarine light. U. S. N. M. Cat. No. 107044.

Description.—An exceedingly slender eel, the length of the head (5.4 mm) contained in the total length 32.2 times and the depth of the body (1.7 mm at two head lengths behind the snout) 102 times; body scaleless, tapering from the head gradually to the tail which is almost thread-like, there is no caudal filament and none appears to have been broken off; a pair of small bony structures coming to the surface of the skin just back of the head (6.3 mm behind tip of snout) in midline of back. This pair stained red in alizarin and can be traced anteriorly a short distance in the flesh, appearing as though each might be a minute tube. The small size renders difficult the study of this organ and its significance is not known. Additional specimens should make possible its dissection and mounting but the author does not wish to spoil the only specimen known. Although this structure is in about

[1] Published with the permission of the Secretary of the Smithsonian Institution. Received September 6, 1938.

[2] HERRE, A. W., *Fishes of the Crane Pacific Expedition*, Field Mus. Nat. Hist., Zool. Ser. **21**: 436. 1936.

[3] The author is very grateful to Mr. Alfred C. Weed, Curator of Fishes, Field Museum of Natural History, Chicago, for several measurements of the type of *Disparichthys fluviatilis* Herre, used in this study.

the same position as a bony projection on the Fierasferidae, its structure is entirely different. In *D. fluviatilis* this same structure occurs as observed by Mr. Weed. I quote part of his letter of Aug. 12, 1938:

> The peculiar bony structure is on the back of our specimen in about the position you describe. With the microscope equipment available it seems to be a bony tube about 0.2 mm in diameter.

No teeth at front of premaxillary, there being a toothless space about the size of the pupil; the first premaxillary tooth is a little enlarged and curved slightly inward followed by smaller teeth; the vomer is enlarged and its anterior portion is longitudinally sharp edged, followed posteriorly at each side by two small tooth-like projections with large bases; the teeth are in single series in both jaws, the maxillary is toothless.

Mr. Weed in his letter to me makes the following comments about the teeth of *D. fluviatilis:*

> The premaxillary teeth are graduated in size from the very large ones in front to much smaller ones behind. The lower teeth are even height, smaller than the large, hooked ones at front of premaxillary but larger than others on that bone. The second tooth on vomer is about half as long as width of iris. It is very thick and heavy at base and strongly hooked. It is separated from the first by about the length of its base.

The anus is far forward, 6.6 mm behind the tip of the snout, and just below the rear edge of the head; the anal fin is well developed, beginning just behind the anus and continuing to end of tail, the rays becoming very feeble posteriorly, so much so it is not possible to correctly count them, the length of the anal rays anteriorly are a little greater than the diameter of the pupil; dorsal fin very feeble, its origin not definitely determinable but probably about 26 mm (4.8 head lengths) behind tip of snout. The jaws are short and blunt, the lower a trifle shorter than upper; premaxillary not protractile; the maxillary lies above the premaxillary and overlapping it, and when the jaws are closed it is almost completely shielded by the fleshy preorbital above.

The long, narrow tongue is adherent to the floor of the mouth; the anterior nostril, somewhat tubular, is a little in advance of midway between eye and tip of snout; the posterior nostril is in the form of a crescent-shaped opening in front of middle of eye, its length about the size of the pupil, and the convex side nearest the eye (in *fluviatilis* Mr. Weed remarks, "Posterior nostril a straight slit 0.5 mm high at front edge of iris. Its lower end is at center of height of eye."); the posterior edge of the large eye is at about the center of the head; the gill openings are wide and extend far forward, but are not confluent, joining the narrow isthmus at its anterior end; the pectorals are small, rounded, their bases somewhat fleshy; the branchiostegals number 6 or (?) 7.

The following measurements[4] (recorded in mm) were made by use of a vernier on a mm rule: Length of head 5.4 (4.8); length of snout 1.6 mm; 0.30; diameter of eye 1.2; 0.22 (1.3; 0.21); length from tip of snout to rear edge of maxillary 2.3; 0.43 (2.2; 0.46); distance from tip of snout to center of anus 6.7; 1.24; tip of snout to center of anterior nostril 0.6; 0.11; depth

[4] The measurements are first given in mm followed by this value divided by the length of the head. Figures inclosed in parentheses are Mr. Weed's measurements of the type of *D. fluviatilis* Herre, and those outside the parentheses are for the new species. The total length of *D. fluviatilis* is too uncertain to express the measurements in hundredths of the standard length.

of head at occiput 2.5; 0.46; depth of body at two head lengths behind tip of snout 1.7; 0.32 (1.3; 0.22); length of longest pectoral fin ray about 0.8; 0.15 (0.75; 0.16); tip of snout to origin of anal fin 7.0; 1.3 (8.0; 1.67); anal fin origin to anus 0.6; 0.11 (4.5; 0.94); tip of snout to bony structure back of head 6.3; 1.17 (5.1; 1.06); width of premaxillary toothless space 0.4; 0.07 (0.05; 0.14); height of base of pectoral fin 0.9; 0.17 (1.0; 0.13); width of iris 0.4; 0.07 (0.4; 0.08).

The pectoral fins have 17 and 18 rays (20 or 21 on left side of *fluviatilis*). By staining the specimen in alizarin it was possible to count with great difficulty about 165 vertebrae.

There are four mucous pores on the preorbital; 7 or 8 black pigment cells on each side of the midline on the upper surface of the snout just above the anterior nostril; about 1+2 or 3 pointed, rather short gill rakers on first gill arch; along midline of belly, a fleshy kiel extends from in front of anus to anterior end of isthmus (also present in *D. fluviatilis*).

The color before staining with alizarin was plain light gray in alcohol.

Although this genus is referred to the eels, it does possess characters which might place it somewhere among the elongate jugular fishes. However, until its skeleton is carefully studied, I believe it should be referred to the apodal fishes.

Only the holotype known.

Named in honor of Dr. A. W. T. Herre who discovered this remarkable family of fishes.

ZOOLOGY.—*List of the gray foxes of Mexico.*[1] E. A. GOLDMAN, Bureau of Biological Survey.

Gray foxes occur throughout Mexico wherever local conditions are suitable. They favor rocky, partially wooded areas, where crevices or cavities afford suitable natural shelter, and are generally absent on broad expanses of open, level plain; but they also invade heavily forested regions in the eastern part of the republic. Gray foxes everywhere climb trees to some extent, especially to escape when hard pressed by enemies, but in the "cloud forests" along the eastern flank of the Mexican tableland and in the nearly unbroken lowland forests of the Yucatan peninsula the arboreal habit is more strongly developed. In these regions the claws are more recurved and sharper than in territory where the foxes are more terrestrial. In the gray foxes individual variation in size and color and in cranial and dental details covers a wide range, but combinations of characters distinguish closely allied geographic races.

The gray foxes in a broad belt extending nearly across the northern end of the Mexican mainland are referred to *Urocyon cinereoargenteus scottii*, which extends into the region from Arizona and Texas. The

[1] Received September 17, 1938.

name *Urocyon cinereoargenteus texensis* for the fox described from the junction of the Devils River with the Rio Grande, Texas, appears to belong in the synonymy of *scottii*, as regarded by Bailey (North Amer. Fauna, **25**: 180, Oct. 24. 1905). Near the Isthmus of Tehuantepec larger foxes give way to decidedly smaller, more southern races, but specimens from the Isthmian region present evidence that intergradation is complete. *Urocyon parvidens* from Merida, Yucatan, proves to be identical with the earlier named animal, *Urocyon cinereoargenteus fraterculus*, from San Felipe, Yucatan. The range of *Urocyon cinereoargenteus californicus* extends from southern California into northern Lower California, but passes farther south into that of *Urocyon cinereoargenteus peninsularis*. Two subspecies are here described as new.

List of Mexican subspecies of Urocyon cinereoargenteus, *with type localities*

Urocyon cinereoargenteus californicus Mearns. San Jacinto Mountains, Riverside County, California (altitude 8,000 feet).

Urocyon cinereoargenteus peninsularis Huey. San Ignacio, southern Lower California, Mexico.

Urocyon cinereoargenteus scottii Mearns. Pinal County (probably near Oracle), Arizona.

Synonym—*Urocyon cinereoargenteus texensis* Mearns. Junction of Devils River and Rio Grande, Texas.

Urocyon cinereoargenteus colimensis subsp. nov. City of Colima (three miles west), Colima, Mexico (altitude 1,700 feet).

Urocyon cinereoargenteus orinomus subsp. nov. Orizaba, Vera Cruz, Mexico (altitude 4,000 feet).

Urocyon cinereoargenteus fraterculus Elliot.. San Felipe, Yucatan, Mexico.

Synonym—*Urocyon parvidens* Miller. Merida, Yucatan, Mexico.

Urocyon cinereoargenteus guatemalae Miller. Nenton, Huehuetenango, Guatemala (altitude 3,000 feet).

Descriptions of new subspecies

Urocyon cinereoargenteus colimensis, subsp. nov.

Colima Gray Fox

Type.—From three miles west of City of Colima, Colima, Mexico (altitude 1,700 feet). No. 33519/45564, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, April 1, 1892. Original number 2378.

Distribution.—Western Mexico, mainly in and along the Sierra Madre and the more elevated parts of the plateau region, from northern Sinaloa south to near the Isthmus of Tehuantepec. Altitudinal range: From sea level along Pacific coast to at least 8,500 feet on mountains bordering the Valley of Mexico.

General characters.—Closely allied to *Urocyon cinereoargenteus scottii* of Pinal County, Arizona, but usually smaller; pelage shorter; color normally darker, the outer sides of feet more mixed with brown or black; cranial details distinctive. Similar in general to *Urocyon cinereoargenteus fraterculus* of Yucatan, and *Urocyon cinereoargenteus guatemalae* of southeastern Mexico and Guatemala, but decidedly larger than either, and skull characters different.

Color.—Type (pelage somewhat worn): Upper parts in general a coarsely grizzled mixture of gray and black, the gray predominating, and the black most strongly in evidence on tips of longer guard hairs along median line of back; outer sides of forearms and thighs grayish buff; under parts in general whitish, becoming pinkish buffy on sides of neck and along sides of abdomen; chin blackish; muzzle grayish brown, darkest at base of vibrissae; ears clothed with buffy hairs, becoming rusty reddish or tawny at posterior base; sides of neck ochraceous tawny; lower part of cheeks white in continuation with white of throat; upper and outer sides of feet light buff, finely mixed with brown, the inner sides pale buff; tail with a narrow, black crest, as usual in the group, giving way abruptly to grayish buff along sides and pinkish buff below, becoming black all around at tip. In some specimens the postauricular areas are paler, less tawny, and the buff on sides of neck and abdomen lighter in tone.

Skull.—Closely resembling that of *scottii*, but somewhat smaller; braincase narrower; rostrum broader; nasals shorter; jugal narrower at insertion in maxilla, as viewed from side; interpterygoid fossa shorter; mandible deeper and heavier, more convex in lower outline near symphysis; auditory bullae usually smaller, narrower, less fully inflated; upper carnassial and first upper molar variable but usually smaller. Similar to *guatemalae*, but decidedly larger, with relatively smaller auditory bullae. Compared with that of *fraterculus* the skull is much larger, with more strongly developed temporal ridges, and relatively smaller, less inflated auditory bullae.

Measurements.—Type: Total length, 960 mm; tail vertebrae, 410; hind foot, 138. Average of three adult female topotypes: 927 (880–965); 385 (360–400); 130 (120–146). *Skull* (type [♂] and an adult female topotype, respectively): Greatest length, 117, 114; condylobasal length, 116, 114; zygomatic breadth, 65.6, 64.9; breadth of braincase, 44.2, 44.1; interorbital constriction, 24, 23.7; width of rostrum (just behind exposed canines), 19.2, 19.4; length of nasals, 37.3, 39.5; maxillary toothrow (front of canine to back of last molar), 50.4, 47.8; length of upper carnassial (inner side), 10.3, 10.3.

Remarks.—Specimens from various localities indicate the intergradation of *colimensis* with the closely allied race *scottii* toward the northern end, and along the eastern side of the Sierra Madre. Those from near the Isthmus of Tehuantepec exhibit an approach to *guatemalae*.

Specimens examined.—Total number, 35, as follows:

COLIMA: Colima, 5; Hacienda Magdalena (20 miles southwest of Colima), 1.

DURANGO: Chacala, 2.

GUERRERO: Tlapa, 1.

HIDALGO: El Chico, 1; Tula, 1.

JALISCO: Ameca, 1; Atemajac, 1; Barranca Ibarra (Canyon de Oblatos), 2; San Sebastian, 1.

MEXICO: Huitzilac, 1.

MICHOACAN: La Huacana, 1; La Salada, 2; Los Reyes, 1; Mount Tancitaro, 1; Patzcuaro, 2.

MORELOS: Cuernavaca, 1; Tetela del Volcan, 1.

NAYARIT: Acaponeta, 2; Tepic, 1.

OAXACA: Juquila, 1; Llano Grande, 2.

PUEBLA: Piaxtla, 1.

SINALOA: Sierra de Choix, 1.

ZACATECAS: Hacienda San Juan Capistrano (about 25 miles northwest of Valparaiso), 1.

Urocyon cinereoargenteus orinomus, subsp. nov.

Vera Cruz Gray Fox

Type.—From Orizaba, Vera Cruz, Mexico (altitude 4,000 feet). No. 58411, ♀ adult, skin and skull, U. S. National Museum (Biological Survey collection); collected by Nelson and Goldman, January 18, 1894. Original number 5679.

Distribution.—Eastern Mexico, from southern San Luis Potosi south to central Oaxaca. Altitudinal range: From 2,000 feet at Jalpan, Queretaro to 10,000 feet on Cerro San Felipe, Oaxaca, mainly in the Humid Tropical Zone.

General characters.—A dark-colored, humid tropical forest-inhabiting geographic race, closely allied to *colimensis* of western Mexico, but darker, the upper parts more heavily overlaid with black; postauricular areas deeper tawny; feet usually more clouded with dusky; claws more recurved, laterally compressed and sharper pointed; skull differing in detail, especially the relatively high, narrow braincase. Similar in general to *scottii* of Arizona, but usually smaller; pelage shorter; color darker, the gray element less predominant, the upper parts more heavily overlaid with black; postauricular areas deeper tawny; feet more clouded with dusky; skull smaller, with distinctly narrower braincase. About like *guatemalae* of southeastern Mexico and *fraterculus* of Yucatan in color, but much larger than either, and cranial features different.

Color.—*Type* (fresh pelage): Upper parts a coarsely grizzled mixture of gray and black, the black most strongly revealed on the tips of the longer guard hairs on the neck, back and rump; outer sides of forearms and thighs finely grizzled black and gray, suffused with "ochraceous tawny" (Ridgway, 1912); lower part of cheeks, throat, chest, inguinal region and a line along inner side of hind leg white; under side of neck crossed by a band of "cinnamon-buff," abdominal area irregularly invaded by "pinkish buff," muzzle chin, and lips blackish; ears grayish brown, becoming rich "orange-cinnamon" at posterior base, fading to "cinnamon" on sides of neck; upper sides of feet a mixture of black and gray suffused with buff, the hind feet varying to between "cinnamon" and "orange-cinnamon" along outer sides; tail with a narrow, conspicuous black crest, giving way to buffy gray along sides, and between "pinkish buff" and "cinnamon-buff" below, becoming black all around at tip.

Skull.—Not very unlike that of *colimensis*, but somewhat lighter in structure; braincase still narrower, the vault rising more steeply to median line between parietals; rostrum narrower; dentition similar. Similar in general to that of *scottii*, but somewhat smaller; brain case narrower; nasals shorter;

jugal narrower at insertion in maxilla, as viewed from side; interpterygoid fossa shorter; auditory bullae smaller; dentition variable, much as in *scottii*. Similar to *guatemalae*, but decidedly larger, with relatively smaller auditory bullae. Compared with *fracterculus* the skull is much larger, with more prominent temporal ridges; auditory bullae relatively smaller, less inflated; dentition heavier.

Measurements.—Type: Total length, 935 mm; tail vertebrae, 358; hind foot, 128. An adult male topotype: 948; 376; 125. *Skull* (type [♀] and an adult male topotype, respectively): Greatest length, 111.6, 112,6; condylobasal length, 109.3, 110.7; zygomatic breadth, 65.1, 67.5; breadth of braincase, 42.3, 43.5; interorbital constriction, 22, 23.1; width of rostrum (just behind exposed canines), 18.6, 17.8; length of nasals, 35.9, 36; maxillary toothrow (front of canine to back of last molar), 48.8, 49; length of upper carnassial (inner side), 12.5, 10.7.

Remarks.—The dark coloration of this geographic race seems to be associated with its humid tropical forest habitat. General comparisons indicate intergradation on the north with *scottii*, on the west and south with *colimensis*, and toward the east with *fraterculus* and *guatemalae*.

Specimens examined.—Total number, 10, as follows:

OAXACA: Cerro San Felipe (10 miles north of City of Oaxaca), 1; Totontepec (20 miles northeast of Mount Zempoaltepec), 1.

QUERETARO: Jalpan, 1.

SAN LUIS POTOSI: Rio Verde, 1.

VERA CRUZ: Jalapa, 1; Las Vigas, 1; Orizaba, 4.

ZOOLOGY.—*A new woodrat of the genus* Hodomys.[1] E. A. GOLDMAN, Bureau of Biological Survey.

The genus *Hodomys* includes large, peculiar, tawny-backed woodrats known to range from Rosario, southern Sinaloa, southward at low elevations near the Pacific coast to Acapulco, central Guerrero, southwestern Mexico. One less vividly colored species (*Hodomys vetulus*) inhabits interior valleys as far east as southeastern Puebla, in the Atlantic drainage two-thirds of the distance across the continent. The largest individuals of *Hodomys alleni* present the maximum size attained by any of the many species of North American round-tailed woodrats (type of *alleni:* total length, 472; tail vertebrae, 225; hind foot, 46 millimeters). A new geographic race of lesser dimensions may be known by the following description.

Hodomys alleni guerrerensis, subsp. nov.

Acapulco Woodrat

Type.—From Acapulco, Guerrero, Mexico (sea level). No. 70574, ♂ adult, skin and skull, U. S. National Museum (Biological Survey collection), collected by Nelson and Goldman, January 6, 1895. Original number 7321.

[1] Received September 17, 1938.

Distribution.—Known only from the type locality, but probably has an extensive range at low elevations along the Pacific coast.

General characters.—Closely allied to *Hodomys alleni alleni* of Manzanillo, Colima, but decidedly smaller; color about the same; skull smaller and lighter in structure. Somewhat similar to *Hodomys vetulus* of Tehuacan, Puebla, but larger; upper parts near tawny instead of cinnamon buff; tail unicolor (tail bicolor in *vetulus*); cranial details distinctive.

Color.—*Type* (unworn pelage): Upper parts from top of head over back to rump near "tawny" (Ridgway, 1912) moderately mixed with black, paling to "cinnamon," the dark hairs thinning out along flanks; muzzle, sides of head, areas around eyes, outer sides of forearms and thighs dull grayish brown; under parts dull white, the hairs white to roots along median line from chest to inguinal region and "light drab" under color showing through on throat, inner sides of limbs and sides of abdomen; ears thinly clothed with dusky hairs; fore feet dull white; hind feet whitish mixed with brownish black, the ends of toes clothed with tufts of silvery white bristles; tail thinly haired, black all around. In most of the topotypes the basal color on the under parts is uniformly "light drab" and the hind feet are more extensively mixed with brownish black.

Skull.—Very similar to that of typical *alleni*, but smaller and of lighter proportions; maxillary arm of zygoma slenderer; molars relatively smaller. Compared with that of *vetulus* the skull is similar in general form but larger, more elongated; interparietal longer; molar toothrows longer and actually as well as relatively narrower.

Measurements.—*Type:* Total length, 408 mm; tail vertebrae, 200; hind foot, 42. Average of four adult topotypes: 423 (390–446); tail vertebrae, 206 (181–224); hind foot, 42 (40–43). *Skull* (type [♂] and an adult female topotype, respectively): Occipitonasal length, 49.8, 50.7; zygomatic breadth, 24.9, 24.7; interorbital constriction, 6.1, 5.9; length of nasals, 19.2, 19.9; length of incisive foramina, 9.5, 9.5; length of palatal bridge, 9.5, 10; maxillary toothrow (alveoli), 10.4, 10.1.

Remarks.—*Hodomys alleni guerrerensis* is a southern geographic race, distinguished from typical *alleni* mainly by smaller size. It requires no close comparison with *vetulus* of the interior valleys to the northward, although the two are not very distantly related.

Specimens examined.—Twelve, all from the type locality.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

RECENTLY ELECTED TO RESIDENT MEMBERSHIP IN THE ACADEMY

CLARENCE COTTAM, senior biologist, Bureau of Biological Survey, in recognition of his contributions to the knowledge of the food habits and economic status of vertebrates and to wild life conservation.

ERNEST WERNER EICKELBERG, assistant chief, Division of Terrestrial Magnetism and Seismology, U. S. Coast and Geodetic Survey, in recognition of his work on the magnetism of the United States and the development of magnetic observations at sea.

NED ROYCE ELLIS, senior chemist, Bureau of Animal Industry, in recognition of his contributions to the nutrition of animals and particularly the chemistry of animal fats.

CLEMENT LEINSTER GARNER, chief, Division of Geodesy, U. S. Coast and Geodetic Survey, in recognition of his contributions to geodetic and hydrographic surveying, and in particular his researches covering geodetic observing methods and improvements in instruments.

LAWRENCE HENRY JAMES, professor of bacteriology and head of department, University of Maryland, in recognition of his researches on food bacteriology and microbial thermogenesis.

RAYMOND ALEXANDER KELSER, chief, Veterinary Corps, U. S. Army, in recognition of his contributions in the field of veterinary bacteriology.

ALLEN MCINTOSH, associate zoologist, Bureau of Animal Industry, in recognition of his contributions to the taxonomy of helminths of wild animals and birds.

JAMES EDWARD MCMURTREY, JR., senior physiologist, Bureau of Plant Industry, in recognition of his work in plant physiology, particularly plant nutrition.

CHARLES WILLIAM REES, associate zoologist, Bureau of Animal Industry, in recognition of his contributions to medical and veterinary protozoology.

FRANCIS M. UHLER, associate biologist, Bureau of Biological Survey, in recognition of contributions in the field of food habits and economic status of birds, mammals, reptiles and amphibians.

EGBERT HAMILTON WALKER, Division of Plants, Smithsonian Institution, in recognition of his studies on the taxonomy of Chinese plants and the preparation of a bibliography of eastern Asiatic botany.

LAWRENCE ARNELL WOOD, assistant physicist, National Bureau of Standards, in recognition of his work on electrical properties of semi-conductors in particular his researches on the Hall effect and on blocking-layer photocells; also work on the physics and chemical thermodynamics of rubber.

SCIENTIFIC NOTES AND NEWS

SCIENTIFIC EVENTS

American Ornithologist's Union.—The American Ornithologist's Union held its fifty-sixth stated meeting in Washington, D. C., at the United States National Museum, October 17–22. The meeting was one of the largest yet held, with a total registration of about 330. Officers elected for the ensuing year were President, HERBERT FRIEDMANN, U. S. National Museum; Vice Presidents, JAMES P. CHAPIN, American Museum of Natural History, and JAMES L. PETERS, Museum of Vertebrate Zoology; Secretary, LAWRENCE E. HICKS, Ohio State University; Treasurer, RUDYERD BOULTON, Field Museum of Natural History. New members of the Council elected for a period of three years were ROBERT T. MOORE, California Institute of Technology, JOHN T. ZIMMER, American Museum of Natural History, and W. L. MCATEE, Biological Survey.

One of the features of the meeting was a symposium (the first in many

years) on the problem of the individual versus the species in modern studies of avian behavior. Another feature was a number of excellent motion pictures in natural color, revealing a great advance over previous natural history photography. On Friday, October 21, there was an all day excursion to the Patuxent Wild Life Research Refuge operated under the auspices of the Biological Survey, while on Saturday morning members inspected the new buildings and collections at the National Zoological Park.

The 1939 meeting is to be held in the San Francisco Bay region, California.

Obituary

VICTOR KNIGHT CHESNUT, for many years a chemist with the Department of Agriculture, died suddenly on August 29 at his home in Hyattsville, Md., at the age of 71.

Born in Nevada City, Calif., Mr. Chesnut studied at the University of Chicago and at George Washington University. He became an assistant professor in chemistry at the University of California in 1890 and was assistant botanist in charge of poisonous plant investigations of the Department of Agriculture from 1894 to 1904. He was made an assistant chemist in the Division of Drugs in the Bureau of Chemistry of the Department of Agriculture in 1907 and served until 1916, when he was made an assistant chemist in the Phytochemical Laboratory. From 1924 until his retirement in 1933 he was an associate chemist in the Bureau of Chemistry and later in the Food and Drug Administration. Mr. Chesnut was widely known as an authority in his field, and contributed frequently to magazines and scientific publications.

A fellow in the American Association for Advancement of Science, Mr. Chesnut was active in the American Chemical Society, which he joined in 1895; he served as president of the Washington Section in 1901. He was a member of the Washington Academy of Sciences (vice president 1901), the American Horticultural Society, the American Civic Association and the Cosmos Club.

GUY N. COLLINS, principal botanist in the Division of Cereal Crops and Diseases of the Bureau of Plant Industry, U. S. Department of Agriculture, died on August 14, 1938, of endocarditis at his home at Lanham, Maryland. Mr. Collins was born at Mertensia, New York, on August 9, 1872. He attended Syracuse University but terminated his college career as an undergraduate in 1895 to join a survey expedition to Liberia for the New York Colonization Society. On his return to the United States in 1898 he spent a few months on the Florida Keys as a free lance botanical collector. Shortly after the close of the Spanish American War he joined the staff of the U. S. Department of Agriculture as Assistant Botanist in the Office of Botanical Investigations and Experiments. The remainder of his life was spent in the service of the Department of Agriculture, his assignments and titles undergoing many transformations.

His first expedition to the American Tropics was in company with O. F. Cook, exploring the newly acquired territory of Puerto Rico and their expedition resulted in the still standard publication "Economic Plants of Porto Rico." Returning from Puerto Rico Mr. Collins entered the Seed Laboratory of the Division of Botany and there devised apparatus for subdividing large lots of seeds into samples for germination and purity tests.

He never lost interest in the statistical problems of seed testing, an interest manifested many years later in the publication "The Application of Statistical Methods to Seed Testing." Many expeditions to the American Tropics followed his trip to Puerto Rico and from one of these came the introduction of the Guatemalan "hard shelled" avocado which has been utilized extensively in developing the commercial varieties of this fruit grown in Florida. While on another of these expeditions to Southern Mexico, accompanied by C. B. Doyle, he collected the Acala variety of cotton now grown extensively in California and the Southwest.

The last thirty years of his service were devoted to a study of inheritance in Indian corn and to the application to that study of biometrical methods without which, he was convinced, no adequate conclusions could be reached. He was among that early group of investigators whose work provided the foundation on which rests the present popular system of producing commercial corn crops from hybrid seed. His studies of inheritance in maize led quite naturally to an interest in the origin of this crop and his articles on the phylogeny, agricultural history, and origin of maize are definite contributions ranking equally in importance to his contributions to maize heredity. His insistence on the use of biometry not only on his own data but on those of his associates in the Bureau of Plant Industry compelled him to contribute much of his time to other investigators, at that time feeling their way through the labyrinth of statistical methods. In this manner he made contributions to much of the research of his colleagues.

Mr. Collins was highly regarded for his absolute honesty and for the objectivity with which he approached all problems whether of a personal or scientific nature. In his death biological science has lost a great spirit always fired with enthusiastic curiosity on scientific questions and one tempered with a reasonableness that can come only with the highest intellectual development.

Mr. Collins was a member of the Washington Academy of Sciences, the Botanical Society of America, the Botanical Society of Washington, the American Genetic Association, the Genetic Society of America, the National Parks Association and the Cosmos Club.

EARL BALDWIN MCKINLEY, bacteriologist, geo-pathologist, and administrator, was lost when the Hawaii Clipper disappeared, 2:11 P.M. (Guam time), July 29, 1938, some six hundred miles southeast of Manila. Dr. McKinley was on his way to the Orient to carry out serological tests bearing on the etiology of leprosy and he was engaged, while en route, with Mr. Fred C. Meier, of the Department of Agriculture, in making studies of the flora of high altitudes, work in aerobiology sponsored by the National Research Council.

Dr. McKinley was born September 28, 1894, at Emporia, Kansas. His university and professional training were received at Michigan, from which he received the degrees of A.B. and M.D., and as a Fellow of the National Research Council at the Pasteur Institute of Belgium at Brussels under the renowned Jules Bordet. McKinley received his M.D. degree in 1922. His first academic positions thereafter were held at Baylor University. Here he served one year as Assistant Professor of Medicine and one year as Professor of Hygiene and Bacteriology. Then came his year at Brussels, following which he was for a year Assistant Professor of Bacteriology and a year Associate Professor of Bacteriology at Columbia University. In 1927 he went to the Philippines as a Field Director of the International Health

Board of the Rockefeller Foundation. While in Manila he was also a member of the Advisory Committee to the Governor General for the control of leprosy and a lecturer at the University of the Philippines. In 1928 he returned to the Occident to become Professor of Bacteriology in Columbia University and the Director of the School of Tropical Medicine at San Juan, Puerto Rico, a part of the University of Puerto Rico under the auspices of Columbia University. In 1931 he was appointed Dean, Professor of Bacteriology, and Director of Research in the Medical School of the George Washington University, positions held by him at the time of his disappearance. His war record comprised twenty-eight months of service of which a year was spent overseas.

Dr. McKinley's scientific connections were too numerous to detail in this brief notice. Most prominent were his memberships in the local and national medical associations, American Society for Experimental Pathology, Society of American Bacteriologists (Editorial Board), American Association of Immunologists (Editorial Board), American Association of Pathologists and Bacteriologists (President), American Association for the Advancement of Science (Executive Committee), National Research Council (Executive Committee, Division of Medical Sciences), Academy of Medicine of Washington, D. C. (organizer and Chairman), Washington Academy of Sciences, Society for Experimental Biology and Medicine, American Leprosy Foundation (Secretary and member, Medical Advisory Board), American Society of Tropical Medicine (Council), American Foundation for Tropical Medicine (Executive Secretary), American Academy of Tropical Medicine (one-time Secretary), American Public Health Association, International Association of Geographic Pathology, Sigma Xi, and the Cosmos Club.

Dr. McKinley's publications, which number more than one hundred, are distributed in various fields: immunology, pathology, ultramicroscopic viruses, tropical medicine, cultivation of *Mycobacterium leprae*, medical history, climate and health, and geography of disease.

"Earl Baldwin McKinley possessed the delving mind of a scientist, the dynamic enthusiasm of a promoter, the altruistic instincts of a humanitarian and the simple friendliness of true gentility."

TRUMAN MICHELSON, ethnologist on the staff of the Bureau of American Ethnology, Smithsonian Institution, died on July 26, 1938, at his home in Washington, D. C. as the result of a heart attack. The son of the famous scientist Albert Michelson, Dr. Michelson was born August 11, 1879 at New Rochelle, N. Y. He received the degree of A.B. from Harvard University in 1902 and the degree of A.M. in 1903 and the Ph.D. degree in 1904 from the same university. During the years 1904 and 1905 he studied at the universities of Leipzig and Bonn. In 1909 and 1910 he studied under Dr. Franz Boas at Columbia University. During the years 1905 and 1906 he was instructor in Latin at the University of Missouri and was connected with the United States Immigration Commission in 1909. On June 1, 1910 he was appointed ethnologist on the staff of the Bureau of American Ethnology, which position he filled until his death. In addition to his duties at the Smithsonian Institution, he was professor of ethnology at George Washington University from 1917 until 1932.

During his 28 years with the Bureau of American Ethnology, Dr. Michelson established himself as the foremost authority on the large and important Algonquian tribes of Indians. Every year during this period he spent a certain time in field researches among the widespread tribes of this group.

In addition to scores of publications, Dr. Michelson left behind him a vast accumulation of manuscript material which is preserved in the archives of the Bureau of American Ethnology. Although the Algonquian Indians constituted his special field, his interest in the field of ethnology and of linguistics were remarkably versatile. A secondary interest of much importance was in the field of Indo-European languages. As an indication of his linguistic ability, he possessed a command of 19 different languages.

Dr. Michelson was a Fellow of the American Association for the Advancement of Science, and of the American Ethnological Society; a member of the American Anthropological Association, Anthropological Society of Washington (president, 1923–25), American Folk-Lore Society, American Philological Association, American Oriental Society, Linguistic Society of America, Washington Academy of Sciences; corresponding member of the Société des Américanistes de Paris.

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